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INSTRUCTION MANUAL

Roband Electronics Limited

ROBAND ROSOA.

MP MASTER
MA24165

TEST GEAR REPAIR SECTION

roband

INSTRUCTION MANUAL

OSCILLOSCOPE
TYPE RO50A

INSTRUMENT SERIAL NUMBER 50A _____

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Roband Electronics Limited. November, 1964.

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IMPORTANT NOTICE

The RO50 oscilloscope is a precision instrument and should only be serviced by suitably qualified engineers with the appropriate test equipment at their disposal.

EHT voltages in this oscilloscope can be lethal and due heed MUST be paid to the relevant warnings in this handbook.

It is strongly recommended that the servicing and setting-up procedures, as detailed in this handbook, are strictly adhered to if optimum performance of the oscilloscope is to be maintained.

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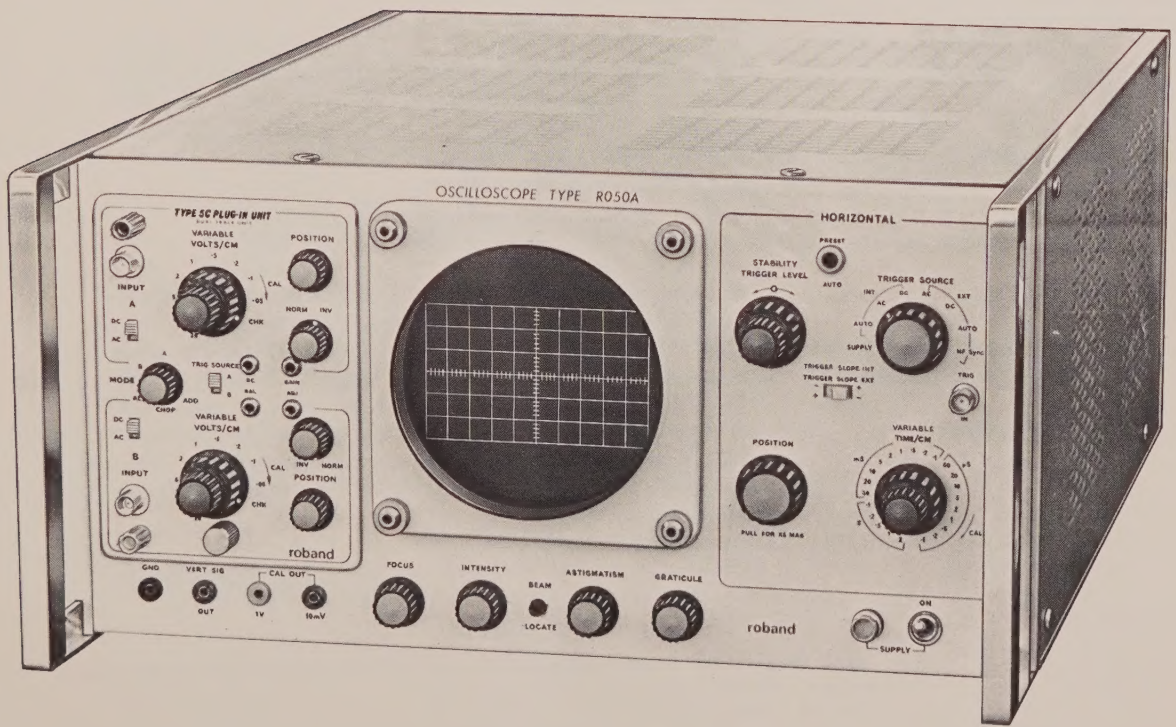
Note that the weight of the unit in the specification should read 41 lb. (18.6 kg.)

CONTENTS

SECTION	1	SPECIFICATION
SECTION	2	OPERATING INSTRUCTIONS
SECTION	3	CIRCUIT DESCRIPTION
SECTION	4	MAINTENANCE AND SERVICE
SECTION	5	CALIBRATION PROCEDURE
SECTION	6	PARTS SCHEDULE
SECTION	7	CIRCUIT DIAGRAMS



SECTION 1
SPECIFICATION

GENERAL

The ROBAND RO50 is a precision oscilloscope having exceptional versatility through the use of the ROBAND 5 series plug-in units. All DC rails, including a special DC rail for amplifier valve heaters, are stabilised. High brightness displays at any sweep speeds are ensured with a 13kv stabilised E.H.T. and can be easily observed even in high ambient lighting conditions. The use of signal delay enables the leading edge of fast-rise pulses to be readily viewed.

VERTICAL DEFLECTION SYSTEM

With factory special Plug-in Units, internal output amplifier, factory-adjusted to the following values -

Bandwidth	: DC to 32Mc/s (frequency response down 3dB ± ½dB at 32Mc/s)
Rise time	: 10 n secs (10% to 90%)

WITH 5K PLUG-IN UNIT

Bandwidth	: DC to 25Mc/s (frequency response down 3dB ± ½dB at 25Mc/s)
Rise time	: 13 n secs (10% to 90%)
Calibrated Sensitivity	: 50mV/cm - 20V/cm
Input Impedance	: 1M Ω ± 2% shunted by 35pf approx.
Input Volts	: 400v (DC + AC) peak.
Position Range	: 3 screen diameters minimum
Measurement Accuracy	: ± 3% relative to max. gain
BALANCED SIGNAL DELAY	: 160 nano secs. permitting observation of leading edge of waveform triggering the sweep

HORIZONTAL DEFLECTION SYSTEM

Sweep Generator	: A feedback controlled constant current charging circuit having an excellent starting time and a clean run-down sweep
Sweep Range	: 0.02µs/cm to 6 sec/cm
Calibrated Sweep Rates	: 23 positions are provided:- 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 µs/cm 0.1, 0.2, 0.5, 1, 2, 5, 10. 20, 50 ms/cm 0.1, 0.2, 0.5, 1, 2 sec/cm Also a variable, uncalibrated control gives continuous adjustment from 0.1 µs/cm to 6 sec/cm approx.
Calibrated Sweep Accuracy (applies to centre 8cms)	: All unexpanded sweeps, typically ± 3% and never greater than ± 4% except .1, .2µs/cm and .5, 1 and 2 sec/cm which are typically ± 4% and never greater than ± 6%
Sweep Magnifier	: X5 magnifier increases amplifier gain to give a fastest sweep of 0.02µs/cm. All expanded sweeps (except .02,.04 and .1µs/cm) deteriorate typically by 1% from unexpanded and by no more than 2%
Expanded Linearity	: 1% typically after first 4 cm
Position Range	: Horizontal control enables any part of an expanded or unexpanded sweep to be brought on to the screen.

TRIGGERING

System	: Tunnel diode trigger circuit giving control over level and amplitude of trigger point.
Modes:	: Internal - Supply, Auto, A.C., D.C., External - Auto, D.C., A.C.
Level Selection	: Internal Range - at least full screen in calibrated position of volts/cm control with all 5 series plug-in units. External Range - ± 7.5 volts.

Automatic Trigger : This position provides a mean level trigger point for most trigger waveforms from 20c/s to 2 c/s. The present stability control is adjustable from the front panel. For this mode the STABILITY and TRIGGER LEVEL are disconnected.

Trigger Requirements : With 5K Plug-in.

FREQUENCY	INTERNAL DEFLECTION	EXTERNAL	INTERNAL AUTO	EXTERNAL AUTO
DC - 2c/s	2 cm	400mV	-	-
2c/s - 20c/s	1 cm	400mV	-	-
20c/s - 10Mc/s	3 mm	400mV	1 cm	1V
10Mc/s - 20Mc/s	1 cm	400mV	2 cm	1V
20Mc/s - 30Mc/s	2 cm	600mV	-	-

UNBLANKING : D. C. coupled to C. R. T. grid to ensure uniform brightness at all sweep speeds. Multiple unblanking is provided from the plug-in unit.

GENERAL

Cathode Ray Tube : 5" flat-faced single gun precision CRT operating at 13kV stabilised to give ultra-bright 6 x 10 cm displays. P31 phosphor is normally supplied; other phosphors to special order

Calibrator : 1V and 10mV rectangular wave (2kc/s approx.) with amplitude accuracy ± 2% max. (typically ± 1%)

External Brightness (Z) Modulation : Accessible at rear of instrument on 4mm sockets

Graticule : Edge-lit two colour variable intensity, engraved in centimetre squares and two millimetre centre line divisions. Illumination is controlled by a front panel knob

Camera Attachment : Accepts all standard cameras on 5" centres

Beam Locate : Operation of the beam locate button limits the swing of the vertical amplifier to a maximum of ± 3cm, ensuring that the beam is always on the screen. The stability is over-ridden, giving a free running sweep.

Output Waveform : A vertical signal is available at a socket on the front panel, the amplitude of which is approx. 0.2v/cm of screen signal up to 2Mc/s approx.

Mechanical Construction : The instrument is housed in a 17" low line case with sides, top and bottom (of plastic covered aluminium), easily removable. The case is readily converted to rack mounting by means of brackets (which are provided) which bolt to its sides. A tilt stand is provided to lift front to a convenient viewing angle.

Cooling : Effective convection cooling under all normal working conditions

Supply Input : 100-125v/200 -250v 45/500 c/s

Power Consumption : 240vA approx. with max. dissipation 5 series plug-in unit.

Dimensions and Weight : Height - $8\frac{3}{4}$" (22cm) Weight - 31 lb (14kg)
Width - 17" (43cm)
- 19" with brackets (48cm)
Depth (excluding handles) - 21" (53.5cm)
Depth (including handles) - 23" (58.5cm)

ACCESSORIES SUPPLIED

1 Mains connector
1 4 mm plug lead
1 Instruction Manual
1 Allan key
1 Spare fuse

ADDITIONAL OPERATION NOTES

SECTION 2
OPERATING INSTRUCTIONS

2.1 GENERAL

The RO50 oscilloscope will only be usable when a Roband 5 series plug-in unit is inserted into the plug-in compartment. It is permissible, however, to switch on the oscilloscope without a plug-in unit in position, as no harm will result from this. The trace will remain approximately in the centre of the screen and no "Y" deflection will be possible.

2.2 PREPARATIONS FOR USE

When the selected Roband "5" series plug-in unit has been firmly screwed home, and the mains voltage selector panel checked for correct setting, the oscilloscope may be switched on. Due to new circuit design, there is no fan or thermal delay with this instrument, but an inherent delay is built into the plug-in unit which delays the operation of the "Y" amplifier for about 40 secs. after the remainder of the oscilloscope is operable.

2.3 CONTROLS

1 INTENSITY - This control adjusts the standing bias on the Cathode Ray Tube and hence, the brightness. It enables you to compensate for changes of occupance with differing sweep rates. The control works in the conventional manner of clock-wise for maximum brightness.
WARNING: ON SLOW OR STATIONARY SPOT DISPLAYS, EXCESSIVE BRIGHTNESS MAY BURN THE PHOSPHOR, PARTICULARLY WHEN PHOSPHORS OTHER THAN STANDARD P31 ARE USED

2 FOCUS AND ASTIGMATISM - These controls when operated together will enable a fine trace to be obtained. For a stationary spot the ASTIGMATISM can be used to give a perfect round shape, while the FOCUS will give a minimum size of spot. At high sweep rates the controls will tend to interact, then focus can be obtained by using the controls simultaneously. It is often found that FOCUS will have most effect on the verticals and the ASTIGMATISM on the horizontals of the picture.

3 GRATICULE - This controls the illumination of the graticle lines. When the oscilloscope leaves the works, the markings come up red when illuminated. If white markings are required, the graticule may be removed and turned through 180°. It will usually be found best to use red lines for visual work, and white for photographic. If a green filter is used, it should go on to the graticule fixing studs, behind the graticule, or the red lines will not show through the filter.

4 BEAM LOCATE - If the trace is off the screen, operation of this button will limit the swing of the vertical amplifier, and at the same time free-run the time base to enable the position of the beam to be found. When the button is pressed, the trace should be centred on the graticule by means of the vertical position control. If the trace still is not visible, advance the INTENSITY control and check the sweep is unmagnified. If the button is now released, the trace should then be on the screen, when the T/B is triggered, unless the oscilloscope is violently overloaded, in which case the beam will swing right across the screen and, unless very high intensities are used, it will not be visible.

5 POSITION CONTROLS -

A VERTICAL - This is always on the plug-in except some special units where it is omitted altogether. The trace moves up for clockwise, and down for anticlockwise. (NOTE This does not apply when a double-beam unit is in use, with TRACE polarity switch on polarity minus, as the whole trace will move in an inverted manner.

B HORIZONTAL - This control is situated in the horizontal display box on the front panel and when operated gives approximately 12cm of position range on normal sweeps, and approximately 60cm on X5 mag.;X5 mag. is obtained by pulling out the HORIZONTAL POSITION KNOB.

6 THE VERTICAL DEFLECTION SYSTEM - The characteristics of the vertical system depend upon the plug-in amplifier in use, and reference should be made to the appropriate handbook for the plug-in unit which you wish to use.

7 THE HORIZONTAL DEFLECTION SYSTEM - In the RO50 there are 23 calibrated sweep speeds from 0.1 micro secs. to 2 secs per centimetre on the TIME PER CENTIMETRE control. These are maintained by precision components to within approximately 2% of each other except on extremes of range. If the VARIABLE TIME PER CENTIMETRE control is used, continuous variation of the sweep rate is possible, from 0.1 micro secs. per centimetre to approximately 6 secs. per centimetre. However, for calibrated sweeps, VARIABLE TIME PER CENTIMETRE must be in the calibrated, i.e. the fully clockwise position.

8 TRIGGER SOURCE SELECTION - There are three available sources of triggering signal in the RO50 -

1 INTERNAL When the triggering sample is derived from the plug-in unit in use.

2 EXTERNAL Where a trigger signal is applied to a TRIGGER IN socket.

3 SUPPLY Where the AC mains is used to initiate the sweep.

As the RO50 has a new fast starting horizontal system, the trigger mode switch which used to be so necessary, has been dispensed with and the types of trigger which are available are as follows:-

A AUTO - This will perform most normal trigger requirements up to approximately 20 megacycles where the trigger point will be approximately the mean level of the input waveform. On AUTO, both on internal and external the STABILITY and TRIG LEVEL controls are disconected and the sweep triggers at the most sensitive point completely automatically.

B AC - This provides for most trigger requirements up to approximately 50 megacycles where control of level is required.

C DC - For frequencies, say, below 20 c/s,this position of the control should be used as complete DC coupling is obtained from input right through to the trigger generator.

D HF SYNC This type of trigger is only found on EXTERNAL and is useful for unusual trigger problems or, as it was used on older oscilloscopes, to synchronize the trace at very high sweep speeds. This position by-passes the tunnel diode trigger generator and allows direct access to the sweep gate binary, thus enabling you to insert your own trigger generator for special requirements.

9 TRIGGER SLOPE - This switch enables you to start the sweep on the rising i.e. positive or falling i.e. negative edge of the triggering wave-form. Although this control is not usually required on automatic triggering, it will however, operate. When you wish to look at the edge of a pulse, trigger slope is particularly important. If an inverting plug-in unit is in use. e.g. the 5C, the 5G or the 5J,Trigger Slope may invert. If very fast sweeps and high signal frequencies are used, say 40 megacycles upwards, it will usually be found that one position of the trigger slope switch will give best results, so both should be tried if difficulty in triggering is encountered. As these frequencies are outside the 3 dB pass-band of the oscilloscope, it will not be possible to adjust the level of the triggering point accurately.

10 STABILITY & TRIGGER LEVEL - In most applications the oscilloscope can be used in the AUTO mode when both these controls are disconnected. However, if you wish to set the level of trigger or when the signal is too complex for auto to be meaningful, the trigger level control should first be placed in the fully clockwise position. The STABILITY should now be advanced clockwise until a trace appears then turn 5° or so back.

Rotating the TRIGGER LEVEL will now cause the sweep to fire when the input firing signal comes within range of the tunnel diode. This enables you to select any point on the wave-form to be viewed.

11 AUTO STAB - This is a preset stability control which is switched in on AUTO mode and should be set to give a locked sweep with 0.5 cm of calibrator wave form.

12 SWEEP MAGNIFIER - This expands the calibrated sweep to 50 cm instead of 10, while still allowing you to view any 10 cm of the trace. When the switch is pulled out, approximately the middle two centimetres expand to fill the whole screen. When X5 MAG is applied the TIME PER CENTIMETRE reading is divided by five, to give the actual trace speed. (Note When the magnifier is applied on the fastest sweep speed, i.e. 20 nano sec. per centimetre, sweep rate errors, of up to 12% of calibration may occur.

2.4 AUXILIARY FUNCTIONS

1 AMPLITUDE CALIBRATOR - This produces a rectangular wave-form of approximately 1 kilo cycle. This is used mainly to check the amplitude calibration of the vertical deflection system of the oscilloscope. It may also be used to compensate attenuators or probes, by adjusting to get a flat top on the screen. The accuracy of the waveform is approximately 1% and always within 2% of the indicated amplitude at the front panel, providing that the setting up of the calibrator DC levels has been done according to the setting-up instructions in this manual.

2 INTENSITY MODULATION - The display of the RO50 can be intensity modulated by a signal applied to the external modulation terminals of the rear of the oscilloscope. Normally a strap is connected across these sockets to reduce the clutter on the trace at high and medium sweep rates. Approximately 20v are required to produce information on the trace at these terminals.

3 VERT. SIG. OUT - This provides a sample of the vertical signal DC connected about earth at a source inpedance of 10K ohms and is primarily intended to check the DC level of the internal trigger amplifier chain.

SECTION 3
CIRCUIT DESCRIPTION

This section of the Handbook gives a description of the circuits used in the RO50 and should be read in conjunction with the circuit diagrams in Section 7. These can be pulled out to lay clear of the handbook to enable both information and circuit to be read together.

3.1 INSTRUMENT OPERATION

Figure 7.1. The General Block Diagram of the RO50 shows the interconnection and signal paths between various circuits. The wave form to be examined is connected to the plug-in unit of the oscilloscope and thence by a plug on the rear of the plug-in compartment to the "Y" amplifier and thence via the delay line to the CRT. A sample of this signal to trigger the time base is also derived from the plug-in unit and passed to the internal trigger amplifier and thence to the TRIGGER SOURCE SWITCH. Whatever the shape or amplitude of the triggering signal, the trigger regenerator either does not respond at all or produces constant amplitude, constant shape, pulses to start the sweep generator. The sweep generator which is controlled by the TIME PER CM switch produces a negative going saw tooth which is amplified by the horizontal amplifier and applied to the X plates of the CRT. The CRT is driven by a 13 KV semi-stabilised high voltage power unit and by a stabilised 1,000 volt cathode supply. In addition a very stable power unit supplies rails for all the units in the equipment.

3.2 VERTICAL DEFLECTION SYSTEM

The input to the vertical deflection system can be any of the Roband "5" series plug-in units and reference should be made to the appropriate Handbook for the Circuit description. The signals from pins A and B on the rear of the plug-in compartment are passed via the series input compensation to the grids of the paraphase output stage. The sensitivity at this point is 140 millivolts per centimetre total input, and this is set by R.V. 2101 SET AMP control which is found on the printed circuit board. As valves V.2101 and V.2102 have an extremely high multual conductance, special arrangements have been made to ensure the stability, and these take the form of decoupling in the suppressors to earth and also screen grid decoupling from the rail. The network R.2118,R.2119,C.2107 is inserted to provide a reference voltage for operating the CRT tube and the voltage called the inter "Y" volts is always the absolute mean of the "Y" plate potentials. The anodes of the vertical amplifier are connected to a shunt compensation network which is terminated by metal film resistors. These have almost zero Q and hence act as reactanceless terminations for the delay line.

3.3 DELAY LINE

This is a 27 section lumped constant L.C. delay line terminated at the input end. The total delay of the "Y" amplifier is approximately 20 nano secs. longer than the delay in the sweep initiation, hence 20 nano secs. of base line can be seen on the CRT display before the displayed pulse appears.

3.4 INTERNAL TRIGGER AMPLIFIER

The triggering signal from Pin C. on the rear of the plug-in compartment is fed to the grid of the E810F. This valve has a DC gain of approximately nine times, but its AC gain rises with frequency to approximately 20 mc/s and then begins to fall off again. This frequency response is arranged by a network in the cathode of R.5102, C.5105 and R.5103, C.5102 and the shunt compensation in the anode L.5101. This frequency characteristic is necessary to ensure stable triggering at all sweep speeds and input frequencies. The voltage at the grid of V.5101 is set by the SET TRIG. 0 control in the appropriate plug-in unit to plus 5 volts, when the output can be set to "O" volts to enable the TRIGGER

LEVEL control to operate in the centre of its range. The control SET TRIG O VOLTS R.V. 5101 compensates for the tolerance in all the components in the trigger amplifier in order to ensure that the output is O volts when the input is + 5V.

3.5 TRIGGER GENERATOR

Triggering signals from the AC mains, TRIG IN socket, or internal trigger amplifier circuit can be connected to the trigger generator via the TRIGGER SOURCE switch and thence to the grids of the tunnel diode binary drivers V. 4101 A and B.

3.6 TUNNEL DIODE BINARY

With the TRIGGER LEVEL control set to zero and no signal input, the current through R. 4107 is divided equally between the two halves of V. 4101. The current in V. 4101 B. plus the current from R.V. 4103 and R. 4111 are added together in the tunnel diode MR. 4101 to hold it just below its peak. As soon as an input signal of the correct polarity is applied to one of the input grids, the tunnel diode swings across its valley and produces a 400 millivolt step at the grid of V. 4102 A. If the current through the tunnel diode remains high,the tunnel will remain in the switched state. If, however, the current drops back immediately due to a fast input wave-form, the tunnel does not switch back to its initial state because of time constant RV. 4102, L. 4101 and R. 4109. This prevents the time base being driven at very high frequencies. The 400 millivolt step from the tunnel diode is amplified via the differentiating pulse amplifier V. 4102 A. and B. and applied to the sweep generator binary. The BEAM LOCATE button acts as an overiding stability control to the sweep gate binary by driving the trigger output lead down towards - 150 volts. The STABILITY and PRESET STABILITY controls, while shown on the trigger generator diagram, are really part of the sweep generator binary and will be discussed with that circuit.

3.7 SWEEP GENERATOR

Sweep Generator is a complex feedback network which for the purpose of explanation will be split into its component parts.

Consider the main feedback loop opened initially. The trigger pulses mixed with the stability control voltage are applied to the grid of V. 7101 a. and hence to V. 7101 b.

3.8 THE SWEEP BINARY

We will assume that V. 7102 is cut off and taking no part in the action. Now V. 7101 b. is normally conducting heavily and its anode and screen are both passing high currents. V. 7102 b. is cut off but its anode is clamped to the + 225 volt rail by MR. 7101 and MR. 7101 in series.

The actual sweep is produced by the constant current valve V. 7104 charging the precision timing capacitors in the timing network. The constant current is controlled by the timing resistor and the VARIABLE TIME PER CENTIMETRE control RV. 7101. This constant current passes through the switching diodes into the cathode of V. 7103 B. When the trigger pulse arrives the sweep gate binary switches, cutting off all switching diodes MR. 7101 through MR. 7106 permitting the constant current to pass into the timing capacitor thus generating a linear ramp. This ramp is negative going starting from approximately + 225 volts and is cathode followed by V. 7107 a, to isolate the impedance of the following circuitry from the timing components. The signal here is split into two paths, one goes via the compensation network SR. 7130, CV 7101 together with R. 7131 and C. 7102 to the sweep output cathode follower, in the grid of which the sweep is mixed with shift information from the position control RV. 7103.

The other sweep path is via RV. 7102 SWEEP LENGTH control to the inverting amplifier, V. 7106. This amplifier is initially bottomed heavily as g. 1. sits at approximately minus 50 volts. As the sweep progresses V. 7106 anode rises at a rate determined by the setting of the SWEEP LENGTH control and takes the grid V. 7102 a. positive, thus switching back the sweep gate binary. However, to ensure that the sweep has time to settle down before receipt of the next trigger pulse, a hold-off capacitor is inserted in the

cathode of V. 7106 B. which is charged via the cathode impedance to the "switch off" voltage. The sweep then returns to its starting potential, and V. 7106 B. cuts off. The hold off capacitor now discharges slowly via R. 7128 and thus holds off the trigger pulses until the time base is ready to receive them. As different amounts of hold-off are needed on different sweep ranges the hold-off capacitor is switched by the TIME PER CENTIMETRE switch to enable the minimum flyback time to be used and thus give a very high repetition rate.

With this system of sweep generation using a constant current feed instead of a conventional Miller, much faster starting and switching times are achieved, the switching being performed by high speed diodes only. Also, the discharge of the timing capacitors is done by a fixed impedance namely the output impedance of V. 7103 B. This ratio of forward sweep to fly back is almost constant hence, at high sweep speeds high repetition rates can be achieved (which are not possible with a Miller type circuit.)

The STABILITY control, or in the auto mode the preset STABILITY, which is shown on the trigger generator diagram, controls the threshold for the trigger pulses. If this threshold is made too positive the sweep gate binary cannot respond to any trigger pulses. If, however, it is made too negative the sweep gate binary will readily be switched before trigger pulses occur and hence no control over the time base will be obtained and free running sweeps will occur.

The use of three diodes in series as a switching diode for the sweep will be noted. This is necessary as the parameters needed in this position are not obtainable in a single device. The diode must be able to "hold off" 100 volts in the reverse direction. It must have almost zero capacity otherwise the sweep gate wave-form becomes superimposed on the sweep at high speeds; It must have negligible leakage or the timing capacitor appears to have a low leak and hence the ramp is not linear but must have very little hole storage or the start of the ramp will be indeterminate. These parameters can best be met by using silicon planar diodes to get the leakage and the hold off voltage and point contact germanium device for the capacity. A similar state of affairs exists in the clamp diodes, but as the problem in not so severe only two diodes, one of them a normal silicon junction, can be used.

As the time base is inherently very simple, very little provision needs to be made for adjustment. The SWEEP LENGTH CONTROL is provided only as a user convenience and does not in any way affect the calibration of the instrument, however, the compensation capacitors CV. 7101, CV. 7102 will affect the linearity and the accuracy of the sweep on fast speeds, and hence should not be moved without reference to the appropriate calibration procedure in this manual.

The sweep generator P.C.B. also produces the sweep gate unblanking pulse, the pulse to fire the Beam switch when in use and accepts any unblanking signal from the plug-in which may be applied by a beam switch unit.

The unblanking pulse is provided by two sources. The DC is obtained from the + VE going pulse which occurs when V. 7101 b. is cut-off by the trigger pulse. However, this pulse although of the correct duration has a poor risetime so a very fast edge is added to the pulse by the bottoming of VT 7102 from the screen of the other half of the binary. The time of this fast pulse is arranged to be less than the fastest sweep time so as not to overide the main blanking at end of sweep time.

Any multi-trace blanking is applied via the pulse transformer T. 7101 from the plug-in unit.

The Beam switch trigger pulse is obtained from VT 7101 which provides a fast-rise pulse at the end of sweep time to switch the binary in the plug-in unit.

3.9 HORIZONTAL OUTPUT AMPLIFIER

The sweep from the T/B generator appears al low impedance at the grid of V. 7210 a., the input to the inverting amplifier. The amplifier valves are fed with constant current by the triodes V. 7201 b. and V. 7202 b. The value of the current is set by the SET X VOLT potentiometer RV. 7202 which is used to set the inter "X" plate voltage. This is

necessary to get optimum line performance from the cathode ray tube. There are two feedback networks in the horizontal output amplifier, one, consisting of a network between the cathodes sets the gain and linearity at high speeds in X1 and X5 separately and RV 7204 which arranges that the grid of V. 7202 a. shall always be at the mean potential of the input to the amplifier.

This ensures that when the magnifier is applied, the sweep magnifies approximately from the centre of the screen without further adjustment. As all the feedback controls in the cathodes of the amplifiers affect calibration of the instrument they should not be moved without reference to the appropriate calibration section of the manual. S. 7201 the X5 MAG control is located on the rear of the horizontal position pot. and is operated by pulling or pushing the knob. The mean anode voltage of the amplifier should be set exactly to the mean "Y" output volts by means of the SET X VOLTS pot, and this voltage is approximately 195 volts, but will vary slightly from instrument to instrument, and from plug-in to plug-in.

3.10 LOW VOLTAGE POWER SUPPLY

This section produces all the convential voltages to operate the amplifiers in the oscilloscope and consists of - 44.1 volts, - 150 volts, + 120 volts + 220 volts, + 270 volts semi-stabilised. A further rail of approximately 320 volts un-stab, is only used to drive the EHT generator which has its own regulator. Each of the power supply rails operates in the conventional manner a sample of the output being compared with a reference voltage, the difference amplified and applied to control valves or transistors. The primary referance for the power supplies is a neon tube V. 8101 which is in the cathode of the difference amplifier for the - 150 volt rails.

The reference for all the other rails with the exception of - 44.1 volt rail is taken from the - 150 volt rail, so that any drift or error will cause all the rails to go together. This helps the calibration to remain constant and drift to be minimised in the amplifiers. Only the - 150 volt, -44·1 volt and the EHT voltage rails are adjustable and if any modification or adjustment is made in this region the whole instrument must be re-calibrated before use. The - 150 volt rail is the primary calibration source of the instrument. The - 44.1 volt has a separate zener diode reference MR. 8122 and MR. 8121 and is itself adjustable as its operation is independant of the rest of the instrument, being mainly used to run the DC heaters in the plug-in units. The + 270 volt rails is obtained by a neon stablising tube V. 8108 from the + 120 volt rail, hence this rail has less regulation than the other rails in the instrument. To cut to a minimum the power in the equipment, each of the positive rails is obtained from two stacked networks MR. 8122 and MR. 8121 and hence some of the electrolytic condenser cases are elevated to high voltage. They are all, however, fully insulated by plastic sleeves and these must on no account be removed.

The heaters for some of the valves in the equipment are elevated + 30 volts to keep to a minimum the heater-cathode potential when the cathode is not at earth. The total consumption from the mains for this instrument is approximately 150 watts, with no plug-in unit fitted. Fuses for the equipment must be of the slow blow or surge resistant type, otherwise they will be found to fail frequently on switching on the instrument. The correct fuse is .75 amp. or 1 amp. on a 240 volt mains and 2 amps. on a 110 volt mains. Thus if your nominal 240 volt supply is rather low and the instrument is operated on the 220 volts main tap it will be found that the 750 milli-amp fuse will be somewhat unreliable and the 1A fuse will have to be fitted for continuous switch-on/switch-off operation. Fuses other than the type specified in the parts lists should not be used and in case of difficulty they can be obtained from Roband Electronics Ltd. Part No. F. 812 for the .75 amp., F. 813 for the 1 amp. and F. 814 for the 2 amp.

3.11 C.R.T. CIRCUIT

The voltages to operate the Cathode Ray Tube are obtained from a modified Hartley oscillator V. 3102 and the transformer T. 3101. The most highly stable rail, the - 1KV cathode supply is derived from V. 3103 and its decoupling network R. 3111, C. 3102 and C. 3106. The reference for this rail is again the - 150 volt supply with which it is compared by R. 3108, 3109 and SET 1 KV POT. RV. 3101 in conjunction with R. 3107.

Any error between the resultant voltage and - 150 volts is amplified by V. 3101 and passed to the screen of the oscillator which is driven either more or less positive to bring the cathode rail back to -1kV. A 13kV supply is obtained from a triplerof V. 3104, V. 3106, V. 3107 with their associated capacitors and is fed via a coaxial cable to the CRT. This cable is special high capacity cable and should not be replaced by ordinary coaxial. The floating supply of V. 3108 and its associated components takes the voltage at the intensity control and the unblanking wave form and makes them 1200 volts or so more negative in order to drive the CRT grid more negative than its cathode.

3.12 FOCUSSING ARRANGEMENTS

The cathode ray tube used in the RO50 is of the mesh type and needs rather complex focussing arrangements. The normal focusing is done on A. 2. and the ASTIGMATISM applied to A. 3. and a neck screen. The skirt around the "X" plates is controlled by the RASTER DISTORTION POT. RV. 3106 and the mesh voltage itself is derived from a voltage about 20 volts more negative than this.

The internal screen between the "X" and "Y" plates, the IPS has to be set exactly at the mean of the "X" and "Y" plates to achieve optimum spot size. The "X" and "Y" plate interplate potential is adjusted to be zero and the interplate voltage is applied automatically to the interplate screen from the "Y" amplifier. As the cathode ray tube is so sensitive it is found necessary always to operate it with the shorting strap in the Z modulation terminals otherwise the cathode is insufficiently decoupled and break-through from the oscillator may be observed on the trace. The voltages used to operate the tube are at low impedance and are lethal. NO ADJUSTMENT SHOULD BE MADE INSIDE THE E.H.T. UNIT WITH THE OSCILLOSCOPE SWITCHED ON. REMEMBER E.H.T. UNITS ARE CHEAPER THAN INQUESTS!

AMPLITUDE CALIBRATOR

The calibrator is a rectanglar pulse generator at approximately 1-2 kc/s which is available as a 1 volt or 10 millivolt wave form at a front panel socket. The calibrator wave form is generated from a multi-vibrator VT. 6101,VT. 6102 which is then used to switch a further transistor VT. 6103. This switches the voltage across MR. 6101 to zero or its zener volts and this voltage is divided down to supply the cal. 1 volt potential. The 10 millivolt potential is further divided by precision resistors from this. As the resistors in the potential divider and potentiometer are highly stable, drift of the 1 volt is very low, but it is possible to check the absolute value of the 1 volt with a standard meter as described in the calibration procedure in this manual.

The rise of the wave form is of the order of 0. 1 micro-sec. and there is a very short over-shoot of approximately 1%, however, when the calibrator wave form is used for setting probes or attenuators the time constant of these is usually of the order of 0. 25 milli-sec. and hence this overshoot is no embarrassment. It is, however, very useful when looking at the operation of the trigger generator at very low occupance on the fast speeds and for this reason it is not removed. If, however, you wish to remove or reduce it C. 6104 may be removed entirely or reduced in value when a sliced undershoot

SECTION 4
MAINTENANCE & SERVICE

4.1 GENERAL

As the RO50. has new simplified circuitry and very low power consumption, some of the usual oscilloscope preventative maintenance does not have to be done, however, your oscilloscope should be checked regularly for such things as cracked or overheated printed circuit boards, improperly seated tubes, scorched wires etc. If any of these faults are found, it is essential that they be tracked to their source as quite often cause and effect are not the same component.

4.2 REPLACEMENT PARTS

Replacements for all parts used in the Roband RO50 can be obtained from the manufacturers or their agents, however, as most components are regularly available it is usually easier to obtain these locally. However, some special components are used and these should be ordered from the parts list in this manual. Some components such as switches and printed circuit boards can be supplied fully assembled ready for use, to save trouble shooting time, and we suggest that if a large number of oscilloscopes are operated the stocking of some assembled printed circuit boards would be of advantage to you. Removal details for E.H.T. unit are given at the rear of this section.

4.3 CATHODE RAY TUBE

When removing or refitting a Cathode Ray Tube, both plastic goggles, gloves and protective overalls should be worn. These will protect you in case of an implosion and resultant flying glass. To remove the CRT first carefully disconnect all the leads around the neck and the base having previously checked that the EHT unit is discharged. Also unsolder the black gun shield earthing lead. There is normally a discharge path inside the Cathode Ray Tube, but this should not be relied upon. The CRT can then be taken out through the front panel. When the CRT has been replaced it is necessary to recalibrate some portions of the oscilloscope in particular the sweep and vertical sensitivity. All valves in the RO50 should be renewed to the parts list. If valves from manufacturers not specified are used incorrect performance may result as some valves are aged before use in the oscilloscope but standard check valves will perform to instrument specification.

4.4 TROUBLE SHOOTING

Many apparent faults on the RO50 oscilloscope are in fact improper setting of controls either internally or externally, or a faulty plug-in unit. Hence before starting any servicing it is recommended that the type 5P test unit be plugged in to ensure that this is not the case. As valve failure is the most likely electrical fault the first step is to check for defective valves. It is not recommended that they be tried in a normal valve tester as this is no check for the suitability of the valve within an instrument. Checking by substitution of a known good valve is a far better practice. If a valve turns out to be serviceable it should be returned to its original socket. This will assist in recalibration as the only criterion for useability of a valve is whether or not it works in the particular instrument. If known good valves are not available it is quite often possible to change two valves round in similar positions, e.g. in the sweep generator sweep gate binary or the horizontal output amplifier. If the trouble is then due to faulty valves the fault will change to a different one and an inspection of the circuit will determine the bad valve. Each printed circuit board has a four digit number and each component on the board has a number starting with the same first two digits as in the block diagram figure 7.1. If any components in the instrument requires renewing it is sufficient to quote to Roband Electronics Limited the number of the instrument and the circuit reference number.

4.5 CIRCUIT FAULTS

In the RO50 the only circuit to have an effect on all sections of the oscilloscope is the low voltage power supply and if any trouble with the oscilloscope results in service this should be checked against the figures in this handbook. If a fault does occur in the power unit the instrument must be recalibrated. When checking the voltage of the - 150 volt rail a meter which is known to be accurate to 1% at 150 volts must be used. The standard bench multi-meter is, in general not suitable for this, unless it has been previously checked against a sub-standard. It is recommended that a Digital Voltmeter e.g. Roband RDV 3 should be used for this job.

If a power supply turns out to be at fault the most likely position of the trouble can usually be found by operating the front panel controls of the oscilloscope. With a known working plug-in installed, preferably the 5P test unit, the INTENSITY, FOCUS and the ASTIGMATISM controls should all be turned fully clockwise and the BEAM LOCATE button depressed. If no spot, line or glow results, the most likely trouble is the EHT unit and this should be checked with a high voltage meter. If one is not available, a good check is to look inside the EHT screen and see if the rectifier valve heaters are alight. If they are glowing normally the fault is likely to be the cathode ray tube. If, however, all the rectifiers are out, the fault will probably be in the EHT oscillator unit. If only one is out it is probably the rectifier inoperative. If only a glow is visible on the CRT and no spot or line, the probable trouble is in the horizontal amplifier. If, however, a spot or line results that, when the BEAM LOCATE button is released, cannot be brought back to the screen, the vertical amplifier is suspect. Finally, if only a spot appears and a trace cannot be started by either the BEAM LOCATE button or the STABILITY control a T/B fault should be suspected.

4.6 VERTICAL AMPLIFIER FAULTS

If the fault is found to be in the vertical amplifier this should be checked for balance, working from the input to the output and a shorting unit should be made up of a 33ohm 1 watt resistor on two insulated crocodile clips. This should be clipped first across pins A and B at the rear of the plug-in unit and if the trace appears on the screen the plug-in unit is suspect. The next step is to short the two metal film resistors at the termination coil ends. If this brings the spot onto the screen either the valves or the termination resistors could be suspect. If the spot still does not appear on the screen the shorting strap should be moved down the delay line towards the tube. If finally the shorting strap is connected across the tube pins and the trace is vertically off the screen the CRT should be suspect. If everything checks out normally in the vertical amplifier but a clean response cannot be obtained with a type 5P test unit, new output valves and resetting of the delay line is indicated.

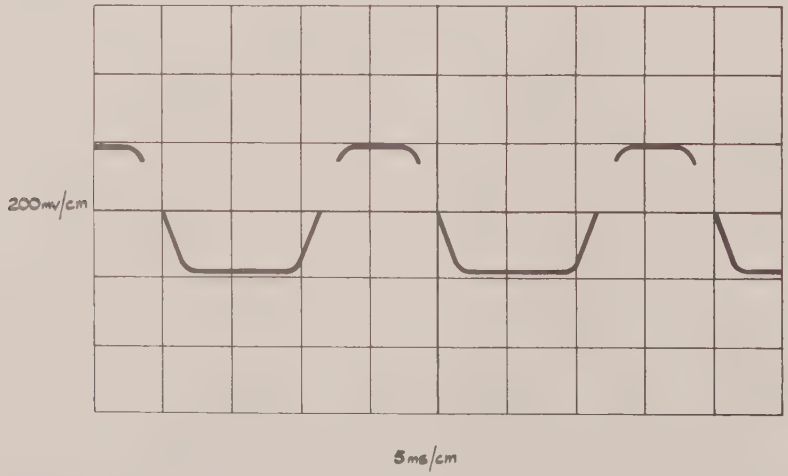


FIG. 4.1 WAVEFORM ON R4112. TRIG. SOURCE ON SUPPLY. OSCILLOSCOPE BEING CORRECTLY TRIGGERED

4.7 TRIGGER CIRCUIT FAULTS

If the waveform obtained on the screen cannot be triggered i.e. made stable, it is probable that the sweep generator is not receiving the correct trigger pulse. To isolate the cause of the trouble, the TRIGGER SOURCE switch should be set to "SUPPLY" and the voltage on R4112 examined with another Oscilloscope.

Fig. 4.1 shows the waveform which should occur as the trigger level control is taken through the zero position, the very fast 400mV tunnel diode pulse being superimposed on a distorted sine-wave. If this waveform does occur, the trouble lies probably in the trigger pulse amplifier, while if just a distorted sine-wave occurs at all settings of the trigger level control it is probable that the tunnel diode or V4101 is at fault. If the waveform is correct the Oscilloscope should now be connected to point 'O' on the trigger generator where the waveform figure 4.2 a negative going spike should be observed. This is superimposed on the D.C. level which is set by the Stability control. This level should vary at least ± 30V about zero, the Time-base triggering when the stability control is most negative. If the trigger is satisfactory at supply frequency but all other frequencies has a jitter, it is possible that the heater cathode insulation of V4101 or V4102 has deteriorated, or hum is appearing on the - 44.1V rail.

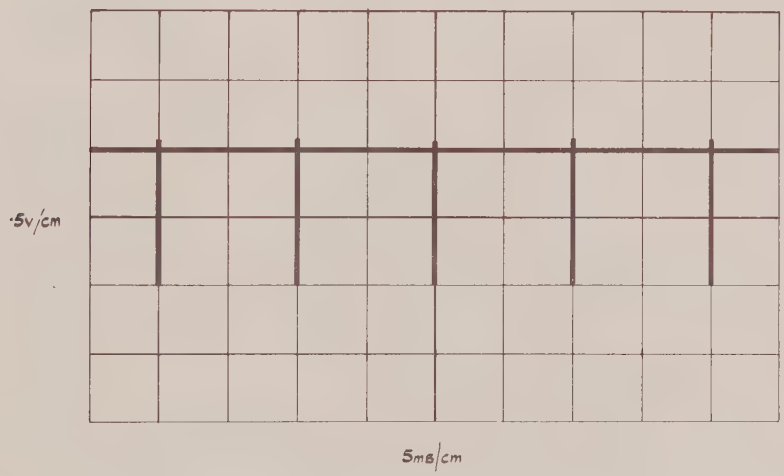


FIG. 4.2 WAVEFORM AT O. TRIG SOURCE ON 'SUPPLY'

4.8 INTERNAL TRIGGER

If a stable display can be obtained on "SUPPLY" or "EXTERNAL" TRIGGER SOURCE but not when internal trigger is selected, the probable fault is in the internal trigger amplifier, or the trigger pickoff in the Plug-in Unit. The waveform at pin 'C' on the Plug-in Unit should be at a DC level of+5.0 volts with signal superimposed on top of this, the amplitude of the signal should be 50mV approx. for every centimeter on the screen with 5C, 5K, 5L or 5P unit and 70mV per cm of the picture on the screen with the 5A and 5G and some other units. The variation between Plug-in Unit trigger signal amplitudes is due to the method of picking off trigger in these Units. On the Unit where trigger is picked off before shift, 50mV per cm is the rule, while the units where trigger is picked off after shift a somewhat higher voltage is usually obtained. If the input waveform to the internal trigger checks correctly, the output waveform should be an amplified version of the signal at a DC level of O volts. The amplitude of the signal depending on frequency of the triggering signal.

4.9 SWEEP SYSTEM FAULTS

No horizontal sweep. If when the BEAM LOCATE is pressed or when the STABILITY control is turned fully clockwise on normal trigger modes no sweep appears, a fault has

occured in either the sweep generator or the sweep amplifier. To isolate the fault to one of these units the following procedure should be adopted:-

If the spot can be moved by the horizontal position control on X1 or when magnifier is applied, the fault lies in the sweep generator. If, however, the spot remains stationary or off the screen altogether, a sweep amplifier fault is more probable. If the sweep generator is at fault it is probable that the sweep gate binary is held hard over one way. To find out which way it is held, the voltage on R7123 should be measured. If the binary is held at start of sweep this voltage will be, approximately, 225V, while if the binary has locked at the end of sweep the voltage may be anything from 200 down to 100 volts.
In the event of the binary being locked at the high end, i.e. start of sweep, V7106A or V1702B should be suspect, or the SWEEP LENGTH adjust control RV7102 may be violently offset causing V7106A to cut off. A further cause of the binary jamming at the high end is MR7102 and MR7101 which may have gone short circuit. If the sweep is held at its most negative V7101B should be suspected, or a short between G2 and G1 of V7106A,

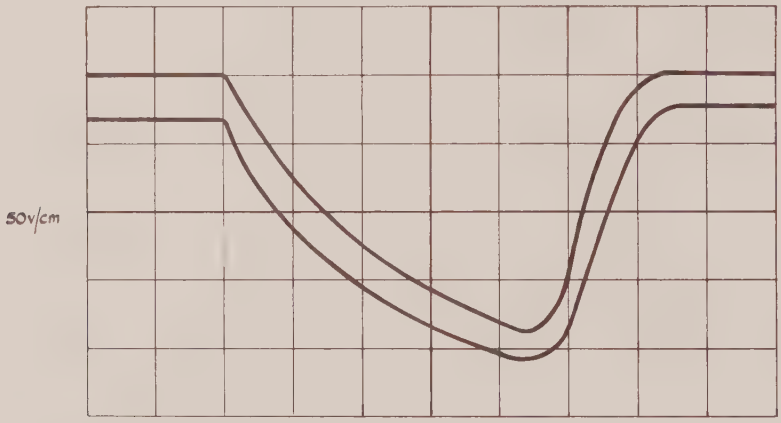


FIG. 4.3 WAVEFORMS WITH SWITCH DIODES SHORT CIRCUIT

4.10 SWEEP TOO SHORT OR NON-LINEAR

If the sweep is non-linear the diodes MR7103 through MR7106 should be checked for short circuit. This fault condition can also be checked by investigating the waveforms on pin 8 of V7103B and the waveform on R7123, if these are of the same form one or more diodes are faulty (See fig. 4.3). Another cause of non-linearity is V7104A or B loosing emission and running into violent grid current . This causes the constant current to vary over the sweep and hence causes nonlinearity. If neither of these is at fault, setting of CV7101, 7102 should be checked with reference to the appropriate calibration section of the Manual. If the sweep is too short and its length cannot be set with the sweep length control to $10\frac{1}{2}$ cm V7106 or V7102A should be suspect, or if the sweep length varies violently with sweep speed being very long at the fast end of the ranges, V7104 should be checked. It should be borne in mind when checking for insufficient sweep length, that the foregoing remarks only apply if the instrument is on calibration. For correct fast sweep see fig. 4.4. If the TIME/CM is inaccurate it is possible that the horizontal amplifier gain has varied violently. A fairly accurate check may be made on this by looking at supply frequency and measuring period between cycles.

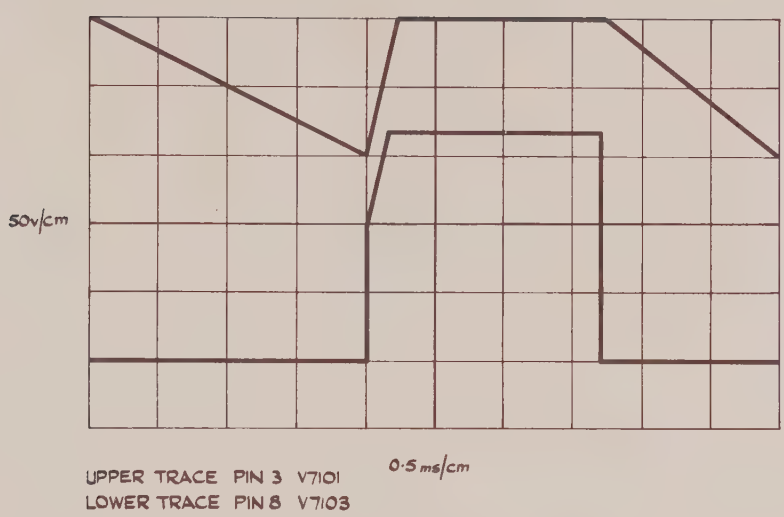


FIG. 4.4 WAVEFORMS ON CORRECT SWEEP

4.11 NO UNBLANKING WAVEFORM

If a bright spot is visible at the beginning of the trace at all intensities, the unblanking amplifier should be checked. The simplest way to check this is to check the waveform across R3167 on the CRT supply board, this should be a 40V positive going waveform during sweep time whose most positive excursion is 120V. If this waveform is present, C3159 is suspect. If it is absent and the most positive excursion of any waveform is less than + 120V, the 7103A should be suspect. If the waveform is entirely absent but the voltage is + 120V, VT7102 should be suspected as a short circuit.

4.12 POOR UNBLANKING ON FAST SWEEP SPEEDS

If the unblanking is sufficient at slow and medium speeds but gets very poor at the high speed end of the sweep generator, VT7102 should be suspect. To check for this condition the waveform across R3167 should again be checked. The rise time of this waveform should be in the order of 100 nano. secs, and have a reasonably linear rise. If the rise is very slow, approximately, 500 or more nano. secs and on an exponential, VT7102 is either open circuit or not receiving the base trigger pulse, in which case MR7107 or C7108 should be suspect.

4.13 MULTI-TRACE UNITS

If a multi-trace unit is in the Plug-in compartment and will not operate on alternate sweeps, VT7101 should be checked. The output of this should be a negative going pulse of, approximately, 20V amplitude with fast rise time but very slow fall time. (See figure 4.5.) This pulse should occur at the end of the sweep gate time, i.e. just as the sweep starts to fly back. If this condition is associated with poor high speed and blanking it is possible that C7106 and/or C1708 have gone short circuit, thus not allowing the pulse across R7137 to be developed.

4.14 HORIZONTAL AMPLIFIER FAULT

If the sweep is too short or non-linear and yet, when investigated on R7201 appears to be perfectly correct, V7201 or V7202 should be suspect. It will usually be found that in the event of the valves losing gain, X5 Mag. accuracy will be affected before the X1 accuracy. If the ends of the trace on X1 and/or X5 cannot be brought over the centre of the screen with the horizontal position control, RV7204 setting should be checked. However, if this is adjusted, sweep Mag. registration will be affected and it will be found on some instruments

that it is not possible to get accurate registration and also shift centring at the same time.

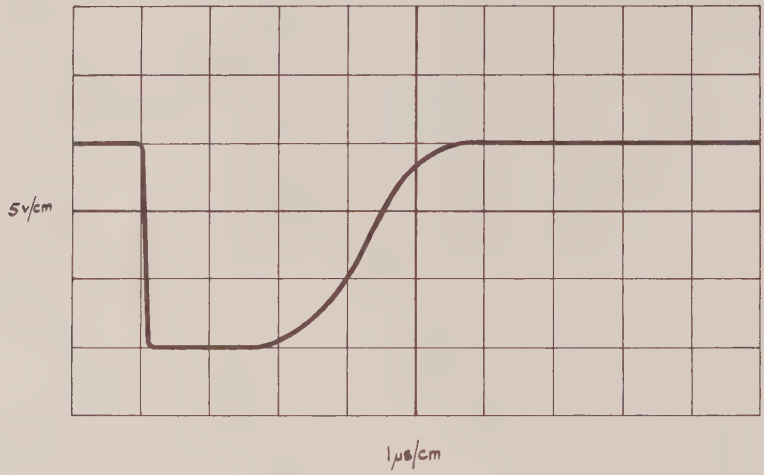


FIG. 4.5 BEAMSWITCH PULSE TO MULTI-TRACE UNITS

4.15 POWER SUPPLY FAULTS

As the Power Supply is a conventional vacuum tube and semi-conductor unit, normal checks will apply. The only source of difference is the fact that the - 150V is used as a reference for all the high voltage power supplies. Also the feed to the reference amplifier in the - 150V rail is from the +270V and +120V supply. This means that in the event of any supply failing the others are affected to a very great extent. If high ripple is suspected, reference should be made to the calibration sheet in the back of this Manual where the actual voltages and ripple voltages for your particular instrument are given. As the outputs of all the rails are heavily de-coupled with an electrolytic capacitor, the impedance of the supply, and hence its regulation, may be drastically out and yet the ripple may not appear to be too excessive. Hence, when checking for suspected poor power supply it is best to monitor the rails and move some of the controls of the Oscilloscope to alter the loading on the power supply. For example, changing the sweep range from the fastest to the slowest will alter the load on the - 150V by 10mA approximately, while removing or inserting a Plug-in, e.g., 5C 5M or 5V it would have a drastic effect on all the rails except 270V. The only limitation on plugging in and out a Plug-in unit with the instrument switched on, is that the high heater current of the valves may eventually shorten the life of the plug and socket. The approximate minimum resistance to earth given in the Table only applies with a cold Oscilloscope and no Plug-in unit installed.

Pin	1	2	3	4	5
Voltage	-44	-150	+120	+225	+270
R Ω	2K	15K	12K	25K	22K

All measurements made with test meter giving correct polarity at output terminals.

FIG. 4.6 POWER SUPPLY APPROXIMATE IMPEDANCE TABLE

If no spot can be obtained on the screen the trouble can be any of the following:-

(a) Low voltage power supplies.
(b) Defective CRT
(c) Defective CRT supply
(d) Unbalanced deflection amplifier

To determine which of the circuits is at fault turn ASTIGMATISM, FOCUS and INTENSITY controls fully clockwise and press the BEAM LOCATE. If a green flare is obtained (assuming standard CRT is installed) a deflection amplifier is probably at fault. If no flare is obtained CRT or power supply should be suspected. Low voltage power supply can be checked by measuring voltage rails while basic operation of the EHT unit can be checked by checking the voltage pin 2, 3 or 4 of the CRT. The rear of the instrument may be hinged up or down to facilitate this.

If the voltage is, approximately, - 1kV either the CRT is at fault, or the tube is receiving excessive bias, or it is just possible that the 13kV supply is so low that no beam current can be obtained. However, even at 2 or 3kV some beam current should be obtained to give a flare on the screen and it is unlikely that a fault has occured which will allow -1kV to be on the cathode and yet not give at least 3kV on the meter. To determine whether the tube is biased off, a multi-meter should be connected between pins 2 and 1 on the CRT base, remembering that these points are at -1kV. If this voltage is between zero and 20V with pin 1 negative then the CRT should be suspect. The voltage between pin 1 and pin 2 should be variable by the INTENSITY control. If the -1kV line has disappeared, V3102 should be suspect, or the heater of V3103. This can be observed by looking into the top of the E.H.T. unit after removing the plastic cover, but great care should be exercised when doing this as + 13kV is immediately under the plastic cover and this voltage is lethal.

WARNING: IT IS VERY DANGEROUS TO SERVICE THE E.H.T. UNIT WITH THE OSCILLOSCOPE SWITCHED ON AND ANY MEASUREMENTS ON THIS UNIT SHOULD BE MADE USING THE VERY GREATEST CARE AS THE IMPEDANCE OF THE SUPPLY IS LOW ENOUGH TO GIVE A FATAL SHOCK.

4.17 POOR FOCUS

If the CRT display cannot be focussed readily, or the focus performance is poor, the voltages on pins 5, 8 and 11 of the CRT should be checked. If the FOCUS and ASTIGMATISM controls appear to go through some form of focus and that the point is undefined, de-coupling capacitors C3161 through C3163 should be checked as ripple on the focussing or astigmatism electrodes of the tube can cause this effect. If all the focussing and astigmatism electrodes are at the correct voltages and free from ripple, the tube should be suspect as it is possible that after rough handling and a long period of use, the A3 aperture in the gun may have become dirty with particles of foreign matter from the mesh and spiral.

IMPORTANT NOTE:

If any of the components in the Oscilloscope circuits are changed, or the set 1kV control or the raster control RV3156 are adjusted, a complete recalibration of the instrument must be done according to the calibration section of this Manual.

4.18 REMOVAL OF EHT BOARD 3100 SERIES

1. Remove top, bottom and right hand side covers.
2. Remove V3101 (EL86 in cooling fin) and V3102 (ECC 189).
3. Disconnect X plate connections from Horizontal amplifier at tube end (pull off) note which way round they are for replacement.
4. Remove the four nuts securing the horizontal amplifier, remove amplifier and fold valves downwards on to sweep generator board (remove no valves from horizontal amplifier or sweep generator). Note that solder tags are always on top of board.
5. Remove the four screws that secure the EHT cover and remove the safety cover.

6. Carefully remove the EHT cover from the framework.

7. With an earthed lead check that - 13kV point (coaxial to the CRT) is discharged

8. Remove the EHT mounting pillar screws from the front except the mounting on C3105 which is removed from the rear.

9. Disconnect all wiring to EHT board, noting the colour of each wire before removal.

10. Re-assemble in reverse order - ensure all screws are tight and that all wiring inside EHT box is clear by 1" of red capacitors, and cableforms well away from board.

11. It will be necessary to reset the 1KV rail by means of the 'preset' on the CRT board (no. RV3150).

12.

CONNECTION	COLOUR CODE	CONNECTION	COLOUR CODE
+225	Orange	-1kv	White
6.3	White	'J'	Yellow-red
-150	Purple	'K'	Grey-Black
0 (GND)	Black	'L'	Yellow-Black
6.3	White		
Set 1kV	Grey		

SECTION 5
CALIBRATION PROCEDURE

5.1 GENERAL

Although the RO50 is a precision Oscilloscope, in use it is very stable and does not require frequent calibration. However, calibration should be checked periodically and when some components in the Oscilloscope are changed, re-calibration of that section should be undertaken.

The calibration is split into four basic sections:-

Main frame which includes the power supply and calibrator.
The "Y" system.
The Trigger system.
The Sweep system.

It is important when calibration is performed on any one section,the other controls in that part of the Oscilloscope should be checked as a large number of them interact, particularly in the sweep generator. Further, it is very important to note that any power supply re-calibration will mean re-checking of the entire instrument, as the whole calibration of the instrument depends on the accuracy of the power supply.

5.2 EQUIPMENT REQUIRED

1. D.C. Voltmeter having resistance of at least 1,000 ohms per volt,accurate to at least 1%. Recommended instrument - Roband Digital Voltmeter RDV3.
2. Variac capable of supplying 250 watts.
3. Time-mark generator giving markers at .1 micro secs. in decades down to at least 100 millisecs. Recommended types - Tektronix types 180A or Video circuits PG7.
4. Calibrated Plug-in Unit, preferably type 5P; or pulse generator of very fast rise time. If type 5P Plug-in is not available suggested type - Tektronix 107 with a 5K Plug-in.
5. Test Oscilloscope, Two-Beam; Bandwidth at least DC to 20 Mc/s with 50 mv/cm sensitivity. Roband RO50 or RO51 with 5C Unit.
6. A low capacity trimming tool to adjust the delay line and the trimmer capacitors in the time base.

5.3 BASIC RE-CALIBRATION

1. - 150V RAIL

With any Plug-in Unit installed and the Oscilloscope working normally the - 150V rail should be set using an RDV3, or any better than 1% DC Voltmeter. The output of the - 44V should then be set using the same meter.

Now check the voltage of all the other high voltage rails, i.e. +120, +225, +270 +unstab., and these should correspond within 5 volts to the voltages indicated on the Calibration sheet at the rear of this Handbook. This Calibration sheet is filled-in in the Factory test room and allows for any adjustment made on the Oscilloscope. To check the ripple of the power supplies,connect the Variac and set the mains 7% low and check the ripple on each rail against the Calibration chart with the test Oscilloscope. Now set the line 7% high and recheck this. The ripple should not vary more than 50% above the indicated value on the Calibration sheet for your instrument.

2. - 1KV. RAIL

Connect the Voltmeter between earth and pin 2 of the CRT and adjust RV3151 on the CRT supply board to read exactly 1000 volts. Now turn the Intensity control from one end to the other and check that this voltage does not vary by more than 2V.

3. INTER X VOLTS

The time base should be turned off by means of the Stability control and the spot set exactly into the middle of the graticule. The volts on pin 'C' of the Cathode Ray Tube should now be measured, this should be approximately, 200V but will slightly depend on the Plug-in in use (see Calibration sheet). To get optimum focus performance from the Oscilloscope this should be checked with 5P Plug-in installed and the voltage noted. Now the voltage from either X plate to earth should be measured with the DC Voltmeter and set by means of the SET X VOLTS POT RV7203 to the inter Y voltage previously noted. After setting this, check that the spot remains in the centre of the screen and if necessary, reset this and check and reset RV7203.

4. RASTER

Connect the 1 volt Calibrator signal to the input of the Plug-in Unit and set the sensitivity to 100mV/cm. Now adjust the Raster control RV3156 on CRT supply board until the calibration lines are all parallel and vertical (see fig. 5.1)

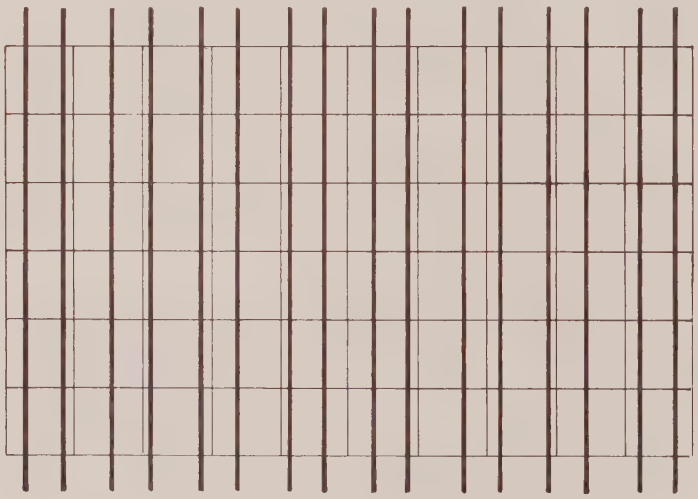


FIG. 5.1 CORRECT SETTING OF 'RASTER' CONTROL

5. CALIBRATOR

Connect a jumper lead between the base of VT6103 and earth and set DC voltage at the CAL OUT 1V terminal to be 1 volt precisely by RV6101. When the jumper is removed the result is a 1 volt peak to peak square-wave. It is not possible to adjust separately the 10mV CAL OUT as it relies on the accuracy of $\frac{1}{2}\%$ precision resistors to achieve this voltage. If the CAL OUT 1 volt is correct but CAL OUT 10mV is not, recourse must be made to changing R6113 and/or R6114 which, if they are to be checked must be checked on a bridge to .1%

5.4 VERTICAL AMP. GAIN

This can be done in one of two ways:-

(1) Install between any Plug-in and the Oscilloscope the adaptor with the CAL SET POINT on it. Connect a jumper lead between CAL OUT 1 volt and the socket on the adaptor. Now set the amplitude of the square-wave on the screen to exactly 4 cm with RV2101.

(2) With any Plug-in Unit installed and the test Oscilloscope very accurately calibrated

set 140mV peak to peak signal at pin 'A' or pin 'B' on the Plug-in Unit. Now set RV2101 to give 2 cm precisely.

5.5 DELAY LINE CALIBRATION

Either the 5P test unit should be plugged into the Oscilloscope compartment, or if the 5P is not available it is possible to use a 5C, 5K or 5L in conjunction with a Tektronix 107 or other fast square-wave generator, but better results are obtained using 5P as it has a basically higher bandwidth than the other Plug-in Unit. The controls of the Oscilloscope should be adjusted so that the second positive-going edge of the pulse generator is visible and the magnifier applied. The line should then be adjusted using a completely non-metallic tool to give a perfectly flat response with a clean front edge. Typical aberrations of the line are shown in figs. 5.2 and 5.3 while 5.4 shows a correctly set up delay line. Fig. 5.5 which is of highly expanded view of correctly set up line shows the three bumps in the line which are inherent in this construction, but these bumps should be less than 1% of the amplitude of the pulse of the 5P Unit.

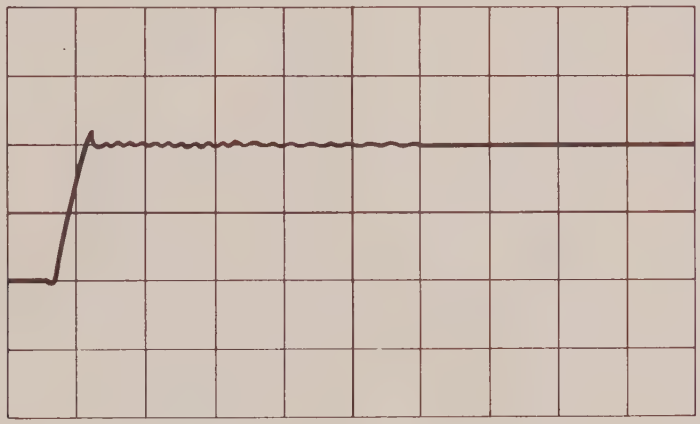


FIG. 5.2 RINGING DELAY LINE

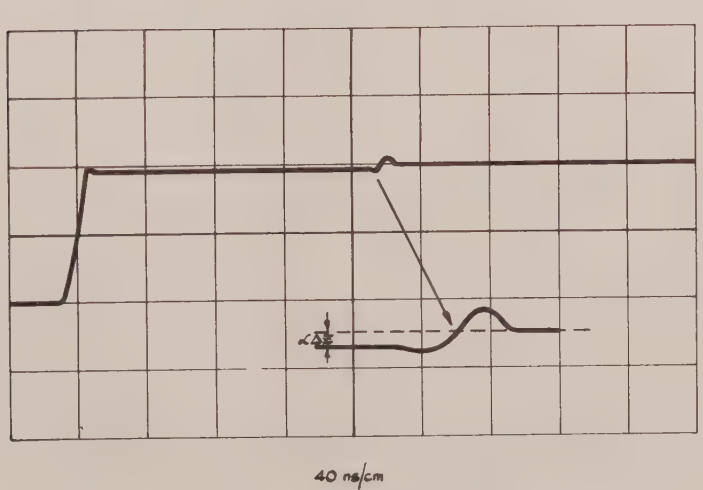


FIG. 5.3 INCORRECT LINE IMPEDANCE

FIG. 5.4 CORRECTLY SET DELAY LINE

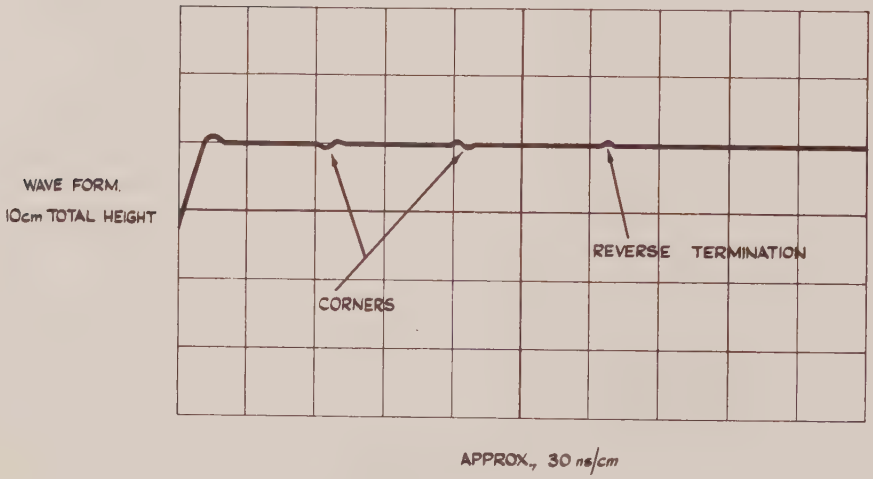


FIG. 5.5 EXPANDED TOP OF CORRECT DELAY LINE

5.6 TRIGGER SYSTEM

1. TRIGGER AMP

With a 5P Unit installed in the Plug-in compartment the voltage at pin C is automatically + 5.0 volts. If any other Plug-in Unit is installed, the voltage at this point should be checked with an accurate DC Voltmeter to be 5.0 volts. When this is achieved, the Voltmeter should be placed between VERT. SIG. OUT and earth and the voltage set to 'O' volts by potentiometer RV5101. (see Fig. 5.6)

2. TRIGGER SENSITIVITY & TRIGGER SET O

Connect the Voltmeter between the slider of the TRIGGER LEVEL control and earth and adjust TRIGGER LEVEL control RV4101A until the voltage is zero. Check that the dot on the knob now coincides with zero screened on the front panel, if it does not, remove the knob and replace so that the dot is aligned with zero. Do not move the

TRIGGER LEVEL from zero during rest of this procedure. Set the controls of the instrument as follows with 5P test Unit installed.

Connect the 10mV CAL OUT to the Input of the 5P Unit, set the controls on the 5P to "AMP", set TRIGGER SLOPE to "INTERNAL POSITIVE", TRIGGER SOURCE to be "INTERNAL AC" and TIME/cm to "1 MICRO SEC." /cm

Connect the test Oscilloscope between R4112 and earth and adjust RV4103 and RV4102 for a 400 mV step which does not change in amplitude when the Trigger Slope Switch is moved from one position to another. This adjustment could also be performed by feeding approximately 50mV of 10 meg. cycles sine-wave into the external Trigger socket and putting the Trigger source switch onto EXTERNAL DC. If this method is used, 10 meg. cycles sine-wave must also be fed to the Plug-in Unit to enable the sine-wave to be viewed on the screen for the next adjustment.

3. PRE-SET STAB

Leaving all controls as in para 5.6.2 except the TRIGGER SOURCE which will be set to "AUTO", either internal or external depending whether 5P is used or an external sine-wave is being fed in. RV4106 PRE-SET AUTO on the front panel should now be set to give a locked picture.

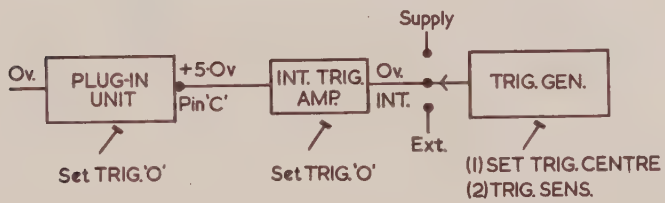


FIG. 5.6 TRIGGER BLOCK DIAGRAM

5.7 TIME BASE

1. OUTPUT COMPENSATION

Set TRIGGER SOURCE to "INTERNAL AC", STABILITY fully clockwise TIME/CM to .1ms/cm. Carefully adjust both X10 probes of the test Oscilloscope and connect 1 beam to pin 3 of V7107A and the other beam to pin 8 of V7107B. The gains of the two channels in the test Ocilloscope should be adjusted to give equal amplitude sweep waveforms. The capacitors CV7101 and CV7102 should now be adjusted to give identical shaped waveform on the two beams; Figs. 5.7 and 5.8 showing the effects of the capacitors being incorrectly set.

The TIME/CM switch should be moved round to the 10 μs/cm position and the adjustment should now be re-checked. Repeat on the 1 μs/cm and the .1 μs/cm positions of the sweep range switch. It is not sufficient to start with the timing switch at .1 μs/cm as the adjustment is so coarse on this position that it is possible to get the two controls both incorrectly set but giving apparently the right result on just one speed. The two trimmers should not now be touched for the rest of the re-calibration procedure. Finally to ensure that the test Oscilloscope is not giving any distortion of the waveform, probes should be changed round as a check.

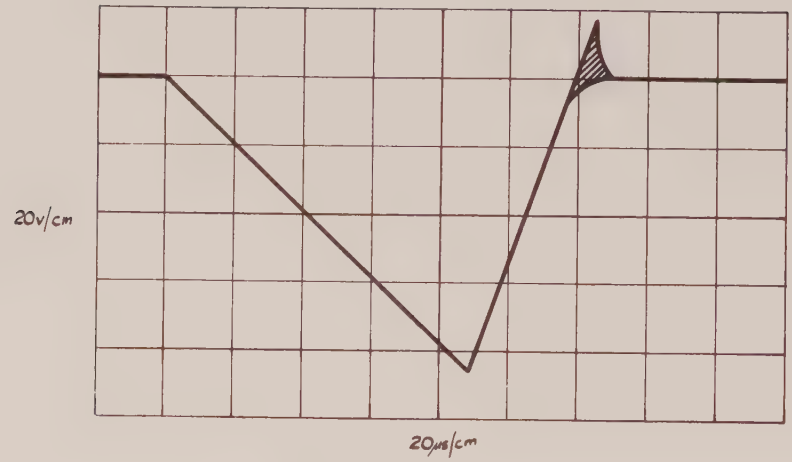


FIG. 5.7 RANGE OF ADJUSTMENT OF CV7101

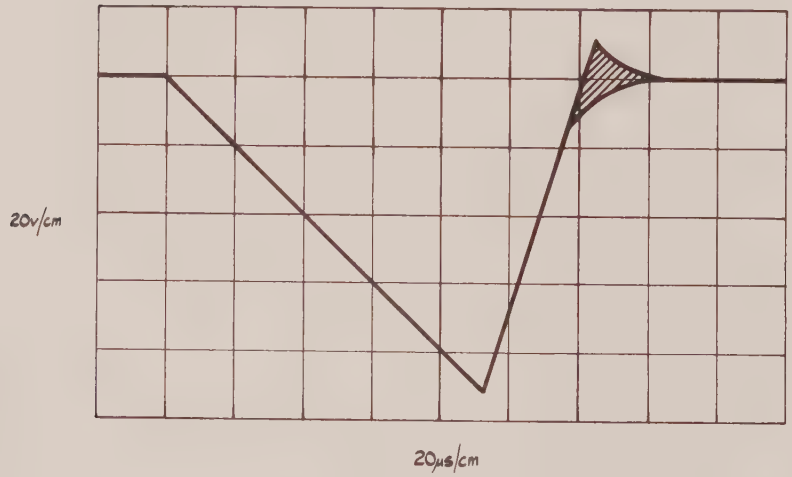


FIG. 5.8 RANGE OF ADJUSTMENT OF CV7102

2. SET X5 GAIN

Set the TIME/CM switch to ". 1ms/cm" and pull the X5 control. Feed 100 μ secs. markers from the time mark generator into the Oscilloscope, set the STABILITY and TRIGGER LEVEL controls to give a stationary picture. Now adjust the set X5 pot. RV7202 to give one marker on the first, centre and last graticule lines. Now push in X5 control and set the X1 control RV7201 to give one marker per graticule line. Now check calibration on 10μs/cm. by feeding 10μs timing marks into the Oscilloscope.

3. X1 COMPENSATION

Set the Oscilloscope to 1μs/cm. and feed . 1μ markers. Set CV7202 to give a linear sweep and in conjunction with CV7121 on the timing switch an accurately calibrated sweep. It may be helpful to connect the test Oscilloscope to the two output

anodes (pins 6 of V7201 and V7202) and adjust CV7202 to give as near identical waveforms as can be achieved before finally lining up the display against the graticule lines. To set the X5 linearity CV7202, pull the X5 control and adjust CV7202 to align .1μs/cm marker of the first, centre and last graticule lines. Finally to check the linearity on X5 Mag on the fastest sweep, a 50Mc/s sine-wave should be fed in as this gives a better check on linearity than timing markers at this speed.

The accuracy as a time base should now be checked and if any errors are found to occur on any range, X1, X5 gain controls should be slightly offset to minimise the error. The variation between ranges between slowest speed and .5μs/cm. should be no more than 2%. The accuracy and linearity on the four fastest speeds is under control of the calibrator and, providing it is done carefully enough, very high orders of accuracy can be achieved except the X5 Magnifier at fastest speed where errors of up to 12% may occur; with careful adjustment these may be cut down to approximately, 5%

4. DC SHIFT CENTRING

No separate provision is made in the amplifier for sweep mag. registration. The DC SHIFT CENTRE control RV7204 for DC centring the horizontal position control also affects the sweep mag. registration, and on any instrument it should be possible to adjust this to give a good compromise between horizontal position centring and magnification from middle of the screen.

IMPORTANT NOTE:

Due to CRT inaccuracies it is only possible to specify the accuracy of the sweep over the centre 8 cm and, if difficulty is encountered in obtaining a linear sweep, the first and last cm should be discounted and linearity obtained over the centre 8 cm only. If this is readily achieved then the CRT is at fault and no attempt should be made to compensate for this.

SECTION 6

PARTS SCHEDULE

VERTICAL OUTPUT AMPLIFIER

All resistors ± 10% class 5 unless otherwise stated
Resistors; Values in ohms
Items indicated * are not part of assembly

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 2101	100K	½W	5%	Class 5	Resista RSX3
R 2102	100K	½W	5%	Class 5	" "
R 2103	1.2K	1W	10%	WW.	Painton 306A
R 2104	10K	1W	10%		Ohmic
R 2105		Not Fitted			
R 2106	2.7K	3W	5%	WW.	Painton 306A
R 2107	2.7K	3W	5%	WW.	" "
R 2108	10	⅛W	10%	Carbon	Erie 15
R 2109	10	⅛W	10%	Carbon	" "
R 2110		Not Fitted			
R 2111	120K	⅛W	10%	Carbon	Erie 15
R 2112	120K	⅛W	10%	Carbon	" "
R 2113	150	½W	5%	Class 5	Resista RSX3
R 2114	150	½W	5%	Class 5	" "
R 2115		Not Fitted			
R 2116	600	2W	2%		Plessey ABF/F
R 2117	600	2W	2%		" "
R 2118	100K	½W	5%	Class 5	Resista RSX3
R 2119	100K	½W	5%	Class 5	" "
R 2151	33	¼W	10%	Carbon	Erie 9
	Potentiometers				
RV 2101	100	½W		Moulded Black	Plessey MP/D
	Capacitors				
C 2101	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	Lemcolac 1. 310K
C 2102	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2103	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2104	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2105		Not Fitted			
C 2106	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	Lemcolac 1. 310K
C 2107	0.002 mfd	350 V	-20%+50%	Tub.Ceramic	" "
C 2108	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2109	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2110		Not Fitted			
C 2111	0.002 mfd	350 V	-20%+50%	Tub. Ceramic	" "
C 2112	0.22 mfd	250 V	20%	Mtl. Polyester	Wima MKS
C 2121	5000 pf	750 V		Ceramic	Lemcolac 13 K
C 2151	40+40 mfd	450 V		TP.Electrolytic	Plessey CE825/1
C 2152	8 mfd	50 V		Electrolytic	" CE1250/1

CCT REF	DESCRIPTION	RECOMMENDED TYPE
	Valves	
V 2101	E 810 F	M.O.VALVE E810F
V 2102	E 810 F	" " "
	Inductors	
L 2103	R.F.Coil Assembly	BRO5/X/3747/2
L 2104	R.F.Coil Assembly	BRO5/X/3747/2
L 2105	Not Fitted	
L 2106	4mm x 2mm Ferrite Bead	Neosid
L 2107	4mm x 2mm Ferrite Bead	Neosid
L 2108	Not Fitted	
L 2109	4mm x 2mm Ferrite Bead	Neosid
L 2110	Not Fitted	
L 2111	4mm x 2mm Ferrite Bead	Neosid
L 2151	4mm x 2mm Ferrite Bead	Neosid
	Switches	
SW 2101	Push Button 1 Make 1 Break on push	Rendar PB-C-O
	Socket	
SK 2101	16 Way Dowel Polarised Red Range	McMURDO RSD16

600 Ω DELAY LINE

CCT REF	DESCRIPTION		RECOMMENDED TYPE
	Capacitors		
C 2601 to C 2638	1 pf ± ½ pf	Ceramic	T.C.C. SCP-2
	Trimmer		
CV 2601 to CV 2639	0.5 pf to 3 pf	Tubular	Erie 535/008
	Coils		
L 2601 to L 2639	Part of Complete Assembly		Roband

CATHODE RAY TUBE SUPPLY

All resistors ± 10% class 5 unless otherwise stated
Resistors, value in ohms.
Resistors indicated + may be 22 or 24 20% 004 012 or 004 013
Items indicated * are not part of assembly

CCT REF	DESCRIPTION				RECOMMENDED TYPE
		Resistors			
R 3101	120K	½W	5%	Class 5	Resista RSX3
R 3102	22K	2W	10%	Carbon	Ohmic
R 3103	4.7K	½W	5%	Class 5	Resista RSX3
R 3104	10K	½W	5%	Class 5	" "
R 3105	22	⅛W	5%	Carbon	Erie 15
R 3106	8.2K	½W	5%	Class 5	Resista RSX3
R 3107	910K	½W	5%	Class 5	" "
R 3108	3.3M	½W	5%	Class 5	" "
R 3109	3.3M	½W	5%	Class 5	" "
R 3110		Not Fitted			
R 3111	10K	½W	5%	Class 5	Resista RSX3
R 3112	330K	½W	10%	Class 5	" "
R 3113	4.7M	½W	5%	Class 5	" "
R 3114	4.7M	½W	5%	Class 5	" "
R 3115		Not Fitted			
R 3116	220K	½W	5%	Class 5	Resista RSX3
R 3166	33K	½W	5%	Class 5	Resista RSX3
R 3167	18K	2W	10%	Carbon	Ohmic
R 3168	10M	½W	5%	Class 5	Resista RSX3
R 3169	1M	½W	5%	Class 5	" "
R 3170	1M	½W	5%	Class 5	" "
R 3171	1M	½W	5%	Class 5	" "
R 3172	8.2K	½W	5%	Class 5	" "
R 3173	1M	½W	5%	Class 5	" "
R 3174	4.7K	½W	5%	Class 5	" "
R 3175		Not Fitted			
R 3176	15	½W	5%	Class 5	Resista RSX3
R 3177	15K	½W	5%	Class 5	" "
R 3178	220K	½W	5%	Class 5	" "
R 3179	10K	2W	10%		Ohmic
		Potentiometers			
RV 3151	470K	½W		Moulded Red	Plessey MP/D
RV 3152	1M	2W		Moulded	Plessey E
RV 3153	1M	2W		Moulded	" "
RV 3154	25K	2W		Moulded	" "
RV 3155		Not Used			
RV 3156	22K	½W		Moulded Green	Plessey MP/D
		Capacitors			
C 3101	0.01 mfd	2KV	25%	Ceramic	Erie CP1 K6994
C 3102	0.01 mfd	2KV	25%	Ceramic	" " "

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Capacitors				
C 3103	500 pf	20KV	-20%+60%	Ceramic	Hunts CTY-5
C 3104	2K pf	5KV	20%		" BK415
C 3105	500 pf	20KV	-20%+60%	Ceramic	" CTY-5
C 3106	0.01 mfd	2KV	25%	Ceramic	Erie CP1 K6994
C 3107	0.01 mfd	2KV	25%	Ceramic	" "
C 3108	0.01 mfd	2KV	25%	Ceramic	" "
C 3109	5K pf	750V	-20%+50%	Ceramic	Lemcolac 13K
C 3159	0.01 mfd	2KV	25%	Ceramic	Erie CP1 K6994
C 3160	Not Fitted				
C 3161	5K pf	750V	25%	Ceramic	Lemcolac 13K
C 3162	0.01 mfd	2KV	25%	Ceramic	Erie CP1 K6994
C 3163	0.01 mfd	2KV	25%	Ceramic	" "
C 3164	0.1 mfd	1KV	20%	Paper	Wima Durolit
C 3165	Not Fitted				
C 3166	5K pf	750V	-20%+50%	Ceramic	Lemcolac 13K
C 3167	5K pf	750V	-20%+50%	Ceramic	" "
	Valves				
V 3101	6 DJ 8				Thorn A.E.I.6DJ8
V 3102	EC 86				Mullard EC 86
V 3103	U 37				M.O.Valve U 37
V 3104	U 37				" " "
V 3105	Not Fitted				
V 3106	U 37				M.O.Valve U 37
V 3107	U 37				" " "
V 3108	U 37				" " "
V 3109	Not Fitted				
V 3110	Cathode Ray Tube 5"				Mullard D13-22-GH
	Transformers				
T 3101	E.H.T.				Roband BR050/W/2987

TRIGGER GENERATOR

All resistors ± 10% class 5 unless otherwise stated.
Resistors, value in ohms,
Resistors indicated + may be 22 or 24 20% 004 012 or 004 013
Items indicated * are not part of assembly

	Resistors				
R 4601	1M	½W	5%	Class 5	Resista RSX3
R 4602	470K	½W	5%	Class 5	" "
R 4603	100K	½W	5%	Class 5	" "
R 4604	1M	½W	5%	Class 5	" "
R 4605	Not Fitted				
R 4606	220K	½W	5%	Class 5	Resista RSX3
R 4607	22	½W	5%		" "
R 4608	22	⅛W	20%		Erie 15
R 4609	47	½W	5%	Class 5	Resista RSX3
R 4610	4.7K	½W	5%	Class 5	" "
R 4611	1K	½W	5%	Class 5	" "

CCT REF	DESCRIPTION				RECOMMENDED TYPE
R 4612	10K	½W	5%	Class 5	" "
R 4613	47	½W	5%	Class 5	" "
R 4614	27K	½W	5%	Class 5	" "
R 4615		Not Fitted			
R 4616		Not Fitted			
R 4617	15	⅛W	10%		Erie 15
R 4618	22	⅛W	20%		" "
R 4619	82K	½W	5%	Class 5	Resista RSX3
R 4620		Not Fitted			
R 4621	56K	½W	5%	Class 5	Resista RSX3
R 4622	10K	½W	5%	Class 5	" "
R 4623	27K	½W	5%	Class 5	" "
R 4624	100K	½W	5%	Class 5	" "
R 4625		Not Fitted			
R 4626	22K	½W	5%	Class 5	Resista RSX3
R 4627	18	¼W			A.Bradley Type CB
R 4628	6.8K	2W	10%		Ohmic
R 4629	12K	½W	5%		Resista RSX3
		Potentiometers			
RV 4612	47K	⅓W	⅝" Spindle - with metal screen		Morganite Type CU
RV 4617	30	2W			Welwyn P 25
RV 4603	100K + 100K	Concentric			Plessey ED
		Outer Shaft 0.265 Dia.x 7/16"long.			
		Inner Shaft .187 Dia.x ⅜"long.			
RV 4623	100K	2W		Moulded	Plessey E
		Capacitors			
C 4601	5000 pf	-20%+50%	750V		Lemcolac 13K
C 4602	5000 pf	-20%+50%	750V		" "
C 4603	5000 pf	-20%+50%	750V		" "
C 4604	5000 pf	-20%+50%	750V		" "
		Capacitors			
C 4605		Not Fitted			
C 4606	5000pf	750V	-20%+50%		Lemcolac 13K
C 4607	0.22 mfd	250V	20%		Wima MKS
C 4608	1000 pf	750V	-20%+50%		Lemcolac 07K
C 4609	5000 pf	750V	-20%+50%		" 13K
C 4610		Not Fitted			
C 4611	100 pf	350V	20%		S.E.I. PF
C 4612	1000 pf	750V	-20%+50%		Lemcolac 07K
		Diodes			
MR 4601					Hughes HG1005
MR 4602					" "
MR 4603	10 mA		Tunnel		R.C.A.1N3848
MR 4604					Mullard OA10
		Transistors			
VT 4601	TO 18	PNP			Texas 2G413
		Valves			
V 4601	6 DJ 8				Thorn A.E.I. 6 DJ 8

CCT REF	DESCRIPTION	RECOMMENDED TYPE
	Transformers	
T 4601	3 T Primary 20 T Secondary - 30 SWG wound on WP3810 (SA 600 Matt) Ferrite Torroid S.T.C.	
	Inductors	
L 4601	16 T - 30 SWG wound on WP3810 (SA 600 Matt) Ferrite Torroid S.T.C.	

INTERNAL TRIGGER AMPLIFIER

All resistors ±10% class 5 unless stated otherwise
Resistors. value in ohms
Resistors, indicated + may be 22 or 24 20% 004 012 or 004 013

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 5101	22	⅛W	50%	Carbon	Erie 15
R 5102	220	½W	5%	Class 5	Resista RSX3
R 5103	220	½W	5%	Class 5	" "
R 5104	2.2K	1W	10%		Ohmic
R 5105	150	½W	10%	Class 5	Resista RSX3
R 5106	22	⅛W	50%	Carbon	Erie 15
R 5107	22	⅛W	50%	Carbon	" "
R 5108	22K	1W	10%	Carbon	Ohmic
R 5109	8.2K	½W	5%	Class 5	Resista RSX3
R 5110	22	⅛W	50%	Carbon	Erie 15
R 5111	56K	½W	5%	Class 5	Resista RSX3
R 5112	56K	½W	5%	Class 5	" "
R 5113	22	⅛W	50%	Carbon	Erie 15
R 5114	39K	1W	10%		Ohmic
R 5115	110K	½W	5%	Class 5	Resista RSX3
	Potentiometers				
RV 5101	47K	½W		Moulded Black	Plessey MP/D
	Capacitors				
C 5101	22 pf	350V	10%	Polystyrene	S.E.I. PF
C 5102	250 mfd	15V		Electroltic	Wima
C 5103	0.005 mfd	350V	-20%+50%	Ceramic	Lemcolac 13K
C 5104	0.002 mfd	250V	-20%+50%	Tub.Ceramic	" Size 1
C 5105	0.002 mfd	250V	-20%+50%	Tub.Ceramic	" "
C 5106	0.002 mfd	250V	-20%+50%	Tub.Ceramic	" "
	Valves				
V 5101	E 810 F				M.O.Valve.E810F
V 5102	6 DJ 8				Thorn A.E.I. 6DJ8
	Inductors				
L 5101	50 mH + 50 mH				BR05/X/3747

CALIBRATOR

All resistors ± 10% class 5 unless stated otherwise
Resistors, value in ohms

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 6101	4.7K	½W	5%	Class 5	Resista RSX3
R 6102	100K	½W	5%	Class 5	" "
R 6103	100K	½W	5%	Class 5	" "
R 6104	4.7K	½W	5%	Class 5	" "
R 6105	Not Fitted				
R 6106	5.6K	½W	5%	Class 5	Resista RSX3
R 6107	4.7K	½W	5%	Class 5	" "
R 6108	220K	½W	5%	Class 5	" "
R 6109	3.3K	½W	5%	Class 5	" "
R 6110	Not Fitted				
R 6111	3.3K	½W	5%	Class 5	Resista RSX3
R 6112	820	½W	5%	Class 5	" "
R 6113	22K	½W	0.5%	Class 0.5	" RMX3
R 6114	223	½W	0.5%	Class 0.5	" "
	Potentiometers				
RV 6101	470	½W		Moulded Black	Plessey MP/D
	Capacitors				
C 6101	0.005 mfd	750V	-20%+50%	Ceramic	Lemcolac 13K
C 6102	0.005 mfd	750V	-20%+50%	Ceramic	" "
C 6103	0.005 mfd	750V	-20%+50%	Ceramic	" "
C 6104	Not Fitted				
C 6105	8 mfd.	50V		Electrolytic	Plessey CE1250/1
	Diodes				
MR 6101	4.5V ± 0.5V	Zener			A.E.I. MR47H
	Transistors				
VT 6101					A.E.I. GT40A
VT 6102					" "
VT 6103					" "

SWEEP GENERATOR

All resistors ± 10% class 5 unless stated otherwise.
Resistors; value in ohms
Resistors indicated + may be 22 or 24 20% 004 012 or 004 013
Items indicates * are not part of assembly

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 7101	22	⅛W		Carbon	Erie 15
R 7102	22	⅛W		Carbon	" "
R 7103	10K	2W	5%	Carbon	Ohmic
R 7104	22	⅛W		Carbon	Erie 15
R 7105	22	⅛W		Carbon	" "
R 7106	680	½W	5%	Class 5	Resista RSX3
R 7107	100K	½W	5%	Class 5	" "
R 7108	15K	½W	5%	Class 5	" "
R 7109	18K	½W	5%	Class 5	" "
R 7110	Not Fitted				
R 7111	68K	½W	5%	Class 5	Resista RSX3
R 7112	3.9K	3W	5%	WW	Painton 306A
R 7113	39K	½W	5%	Class 5	Resista RSX3
R 7114	100K	½W	5%	Class 5	" "
R 7115	33K	1W	10%	Carbon	Ohmic
R 7116	18K	½W	5%	Class 5	Resista RSX3
R 7117	2.7K	½W	5%	Class 5	" "
R 7118	56K	2W	10%	Carbon	Ohmic
R 7119	150K	½W	5%	Class 5	Resista RSX3
R 7120	22	⅛W		Carbon	Erie 15
R 7121	120K	½W	5%	Class 5	Resista RSX3
R 7122	470K	½W	5%	Class 5	" "
R 7123	22	⅛W		Carbon	Erie 15
R 7124	120K	½W	5%	Class 5	Resista RSX3
R 7125	Not Fitted				
R 7126	5.6K	½W	5%	Class 5	Resista RSX3
R 7127	22K	1W	10%	Carbon	Ohmic
R 7128	2.2M	½W	5%	Class 5	Resista RSX3
R 7129	330K	½W	5%	Class 5	" "
R 7130	47K	½W	5%	Class 5	" "
R 7131	47K	½W	5%	Class 5	" "
R 7132	150K	½W	5%	Class 5	" "
R 7133	560K	½W	5%	Class 5	" "
R 7134	22	⅛W		Carbon	Erie 15
R 7135	Not Fitted				
R 7136	15K	1W	10%	Carbon	Ohmic
R 7137	10K	½W	5%	Class 5	Resista RSX3
R 7138	1K	½W	5%	Class 5	" "
R 7139	22K	½W	5%	Class 5	" "
R 7151	1.5K	½W	5%	Class 5	" "
R 7152	68K	½W	5%	Class 5	" "
R 7153	33K	½W	5%	Class 5	" "

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Potentiometers				
RV 7101	1M	½W		Moulded Black	Plessey MP/D
RV 7102	47K	½W		Moulded Black	" "
RV 7103	500K			Carbon	A.B.Metal
	With Push/Pull Switch on rear - Single Pole				PC15472/5955/GS/CAT
	Capacitors				
C 7101	27 pf	350V	10%	Polystyrene	S.E.I. PF
C 7102	0.047 mfd	400V	20%	Mtl.Polyester	Wima 'M'
C 7103	0.047 mfd	400V	20%	Mtl.Polyester	" "
C 7104	150 pf	125V	10%	Polystyrene	S.E.I. PF
C 7105	0.005 mfd	750V	-20%+50%	Ceramic	Lemcolac 13K
C 7106	27 pf	350V	10%	Polystyrene	S.E.I. PF
C 7107	0.1 mfd	400V	20%	Mtl.Polyester	Wima 'M'
C 7108	15 pf	350V	10%	Polystyrene	S.E.I. PF
C 7109	0.005 mfd	750V	-20%+50%	Ceramic	Lemcolac 13K
C 7110	Not Fitted				
C 7111	0.047 mfd	400V	20%	Mtl.Polyester	Wima MKS
C 7112	0.005 mfd	750V	-20%+50%	Ceramic	Lemcolac 13K
	Trimmers				
CV 7101	4 - 40 pf			Compression Mica	Bird MT31/A3
CV 7102	4 - 40 pf			Compression Mica	" "
CV 7151	6 - 30 pf			Ceramic Disc	Steatite Type 12
CV 7152	6 - 30 pf			Ceramic Disc	" "
	Diodes				
MR 7101	75V Silicon Planar				Texas 1N916
MR 7102	75V Silicon Planar				" "
MR 7103	10 mA G.E. Point Contact - low cap				Hughes HG1005
MR 7104	75V Silicon Planar				Texas 1N916
MR 7105	Not Fitted				
MR 7106	75V Silicon Planar				Texas 1N916
MR 7107	10 mA G.E.Point Contact - low cap				Hughes HG1005
MR 7108	10 mA G.E.Point Contact - low cap				" "
	Transistors				
VT 7101	BSY 95A				STC. BSY 95A
VT 7102	ASY 67				Mullard ASY 67
VT 7151	2N3053				RCA. 2N3053
	Valves				
V 7101	ECF 82			Triode Pentode	Thorn A.E.I.ECF82
V 7102	ECF 82			Triode Pentode	" " "
	Valves				
V 7103	6 DJ 8 300 mA Hts at 6.3V				Thorn A.E.I.6DJ8
V 7104	6 DJ 8 300 mA Hts at 6.3V				" " "
V 7105	Not Fitted				
V 7106	ECF 82			Triode Pentode	Thorn A.E.I.ECF82
V 7107	6 DJ 8 300 mA Hts at 6.3V				" " 6DJ8
	Transformer				
TR 7101	Torroid. Ferrite Core				R050/W/3218

SWEEP TIMING SWITCH

All resistors ± 1% class 0.5 unless stated otherwise
Resistors; value in ohms
Items indicated * are not part of assembly

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 7181	30K	1W	1%	Class 0.5	Resista RMX5
R 7182	30K	1W	1%	Class 0.5	" "
R 7183	30K	1W	1%	Class 0.5	" "
R 7184	75K	1W	1%	Class 0.5	" "
R 7185	Not Fitted				
R 7186	150K	1W	1%	Class 0.5	Resista RMX5
R 7187	300K	$\frac{1}{3}$W	1%	Class 0.5	" RMX2
R 7188	750K	$\frac{1}{3}$W	1%	Class 0.5	" "
R 7189	1.5M	$\frac{1}{3}$W	1%	Class 0.5	" "
R 7190	Not Fitted				
R 7191	3M	1W	1%	Class 0.5	Resista RMX5
R 7192	270	$\frac{1}{8}$W	50%	Carbon	Erie 15
R 7122	470K	$\frac{1}{2}$W	5%	Class 5	Resista RSX3
	Capacitors				
C 7121	68 pf	350V	10%	Polystyrene	S.E.I. PF
C 7122	0.001 mfd	400V	1%	Polyester	Wima 'F'
C 7123	0.001 mfd	400V	1%	Polyester	" "
C 7124	0.1 mfd	400V	1%	Polyester	" "
C 7125	Not Fitted				
C 7126	1 mfd	250V	1%	Polyester	Wima MKS
C 7127	100 pf	350V	10%		" 'M'
C 7128	100 pf	350V	10%		" "
C 7129	0.1 mfd	400V	1%	Polyester	" 'F'
	Trimmer				
CV 7121	2 - 20 pf			Compression Mica	Bird HT31/A9
	Potentiometer				
RV 7101	1M	2W		Moulded Spindle length $\frac{3}{4}$" from mounting face Plain spindle to be drilled to AR05/P/3718	Plessey 'E'
	Switch				
SW 7101	Rotary 3 Pole 23 Positions				Jean Renaud

HORIZONTAL AMPLIFIER

All resistors ± 10% class 5 unless stated otherwise
Resistors; value in ohms
Resistors indicated + may be 22 or 24 20% 004-012 or 004 013

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 7201	22	⅛W	50%	Carbon	Erie 15
R 7202	22	⅛W	50%	Carbon	" "
R 7203	8.2K	1W	5%	Class 5	Resista RSX5
R 7204	Not Fitted				
R 7205	Not Fitted				
R 7206	Not Fitted				
R 7207	56K	½W	5%	Class 5	Resista RSX3
R 7208	10K	1W	5%	Class 5	" RSX5
R 7209	22	⅛W	50%	Carbon	Erie 15
R 7210	Not Fitted				
R 7211	22	⅛W	50%	Carbon	Erie 15
R 7212	2.2K	1W	10%	Carbon	Ohmic
R 7213	Not Fitted				
R 7214	2.2K	1W	10%	Carbon	Ohmic
R 7215	Not Fitted				
R 7216	22	⅛W	50%	Carbon	Erie 15
R 7217	22	⅛W	50%	Carbon	" "
R 7218	4.7K	2W	10%	Carbon	Ohmic
R 7219	4.7K	2W	10%	Carbon	"
R 7220	Not Fitted				
R 7221	39K	½W	5%	Class 5	Resista RSX3
R 7222	22K	½W	5%	Class 5	" "
R 7223	820	½W	5%	Class 5	" "
R 7224	2.2K	½W	5%	Class 5	" "
R 7225	Not Fitted				
R 7226	47K	½W	5%	Class 5	Resista RSX3
R 7227	Not Fitted				
R 7228	22	⅛W	10%	Carbon	Erie 15
R 7229	22	⅛W	10%	Carbon	" "
	Potentiometers				
RV 7201	4.7K	½W		Moulded Yellow	Plessey MP/D
RV 7202	470	½W		Moulded Black	" "
RV 7203	22K	½W		Moulded Green	" "
RV 7204	47K	½W		Moulded Black	" "
	Capacitors				
C 7201	0.047 mfd	400V	20%	Mtl.Polyester	Wima 'M'
C 7202	0.002 mfd	350V	-20%+50%	Ceramic	Lemcolac 310K
	Trimmers				
CV 7201	4 - 40 pf			Compression Mica	Bird MT31/A3
CV 7202	2 - 20 pf			Compression Mica	" MT31/A9

CCT REF	DESCRIPTION	RECOMMENDED TYPE
	Valves	
V 7201	ECF 804	Thorn A.E.I. ECF804
V 7202	ECF 804	" " "
	Switch	
SW 7201	Part of RV 7101 on PL 50A/3103 PL 50A/3152	

POWER SUPPLY FILAMENT DISTRIBUTION DIAGRAM

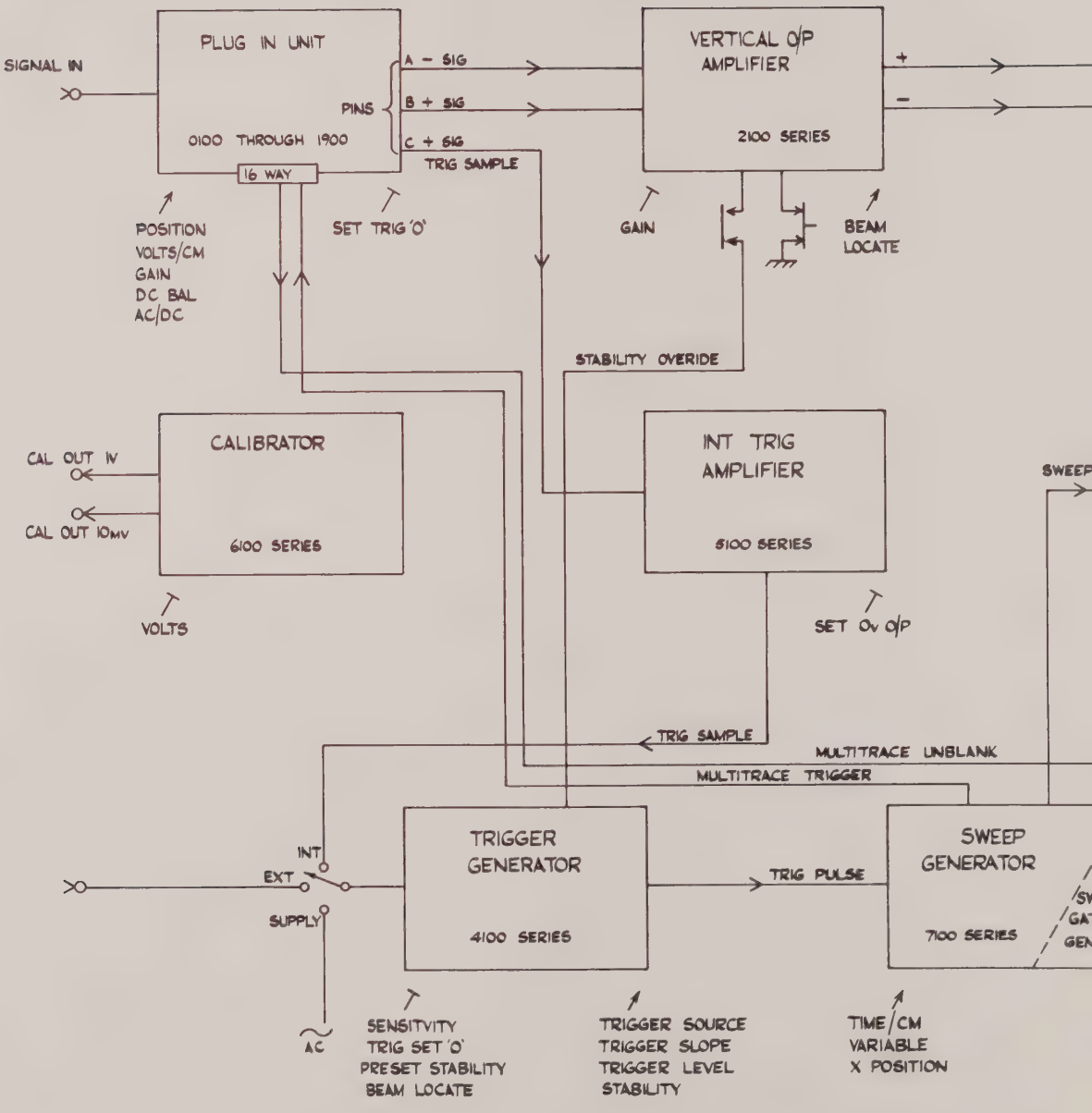
All resistors ± 10% class 5 unless stated otherwise
Resistors, value in ohms
Resistors indicated + may be 22 or 24 20% 004-012 or 004-013
Items indicated * are not part of assembly

CCT REF	DESCRIPTION				RECOMMENDED TYPE
	Resistors				
R 8101	10	3W	5%	WW	Painton 306A
R 8102	56K	½W	5%	Class 5	Resista RSX3
R 8103	5.6K	½W	5%	Class 5	" "
R 8104	12K	½W	5%	Class 5	" "
R 8105	3.3K	½W	5%	Class 5	" "
R 8106	33K	½W	5%	Class 5	" "
R 8141	2.2	1½W	10%	WW	R.C.S.C.RWV-3-J
R 8142	1.8K	½W	5%	Class 5	Resista RSX3
R 8143	39K	½W	5%	Class 5	" "
	Potentiometers				
RV 8101	4.7K	½W		Moulded Yellow	Plessey MP/D
RV 8104	25	1W		WW	A.B.Metal 73
	Thermister				
TH 8101	K.13				Sentel K13
	Capacitors				
C 8101	800+400 mfd		90V	T/Prong	Plessey CE17442/12
C 8102	0.047 mfd		250V 20%	Mtl.Polyester	Wima MKS
	Diodes				
MR 8101	½A	400V	Silicon		Thorn A.E.I.BY114
MR 8102	½A	400V	Silicon		" " "
MR 8103	½A	400V	Silicon		" " "
MR 8104	½A	400V	Silicon		" " "
MR 8121			Zener		A.E.I. VR13F
MR 8122			Zener		" "
	Transistors				
VT 8101	B.C.Y. 34				Mullard BCY34
VT 8102	A.C.Y. 17				" ACY17

CCT REF	DESCRIPTION	RECOMMENDED TYPE
VT 8103	O.C. 28	" OC28
VT 8104	O.C. 77	" OC77
	Lamp	
LP 8101	200-250V Neon Indicator	Arcolectric SL80/Clear
LP 8102	6.3V 1W Lamp Tubular	Hivac 6S1
LP 8103	6.3V 1W Lamp Tubular	" "
	Fuselink	
F 8101	1A Size 00	Beswick TDC134
	Switch	
SW 8101	Toggle Switch 2 Pole 2Way (with knurled ring)	Painton 323652

CCT REF	DESCRIPTION			RECOMMENDED TYPE
	Resistors			
R 8107	27K	1W 10%	Carbon	Ohmic
R 8108	82K	½W 5%	Class 5	Resista RSX3
R 8109	10K	½W 5%	Class 5	" "
R 8110	Not Fitted			
R 8111	56K	½W 5%	Class 5	Resista RSX3
R 8112	33	1W 10%	Carbon	Ohmic
R 8113	82K	½W 5%	Class 5	Resista RSX3
R 8114	100K	½W 2%	Class 2	" "
R 8115	Not Fitted			
R 8116	82K	½W 2%	Class 2	Resista RSX3
R 8117	47	2W 10%	Carbon	Ohmic
R 8118	82K	½W 5%	Class 5	Resista RSX3
R 8119	220	6W 5%	WW	RCSC.RWV-4-L
R 8120	Not Fitted			
R 8121	100	3W 5%	WW	Painton 306A
R 8122	33	1W 10%	Carbon	Ohmic
R 8123	56K	½W 5%	Class 5	Resista RSX3
R 8124	82K	½W 2%	Class 2	" "
R 8125	2.7K	1½W 5%	WW	RCSC.RWV-3-J
R 8126	120K	½W 2%	Class 2	Resista RSX3
R 8127	Not Fitted			
R 8128	22	⅛W 20%	Carbon	Erie 15
R 8129	22	⅛W 20%	Carbon	" "
R 8130	22	⅛W 20%	Carbon	" "
R 8131	22	⅛W 20%	Carbon	" "
R 8132	22	⅛W 20%	Carbon	" "
R 8133	3.9K	3W 10%	WW	Painton 306A
R 8134	3.9K	3W 10%	WW	" "
R 8135	Not Fitted			
R 8136	22	⅛W 20%	Carbon	Erie 15
R 8151	100K	½W 5%	Class 5	Resista RSX3
R 8152	22	⅛W 20%	Carbon	Erie 15
R 8153	22	⅛W 20%	Carbon	" "
R 8154	300K	½W 2%	Carbon	Radio Resistor 5SCD3
R 8155	Not Fitted			

CCT REF	DESCRIPTION				RECOMMENDED TYPE
R 8156	150K	½W	2%	Class 2	Resista RSX3
R 8157	22	⅛W	20%	Carbon	Erie 15
R 8158	2.2M	½W	5%	Class 5	Resista RSX3
		Potentiometers			
RV 8102	22K	½W		Moulded Green	Plessey MP/D
		Capacitors			
C 8104	0.047 mfd	250V	20%	Mtl.Polyester	Wima MKS
C 8105		Not Fitted			
C 8106	200+200+100 mfd	275V		T/Prong	T.C.C.CE159HC
C 8107	0.047 mfd	250V	20%	Mtl.Polyester	Wima MKS
C 8108	200+200+100 mfd	275V		T/Prong	T.C.C.CE159HC
C 8109	200+200+100 mfd	275V		T/Prong	T.C.C.CE159HC
C 8110		Not Fitted			
C 8111	100+60 mfd	450V		T/Prong	T.C.C.CE158HC
C 8112	0.047 mfd	250V	20%	Mtl.Polyester	Wima MKS
C 8113	200+200+100 mfd	275V		T/Prong	T.C.C.CE159HC
C 8114	0.002 mfd	-20%+50%	350V	Ceramic	Lemcolac 310K
C 8151	0.22 mfd	400V	20%		Wima 'M'
		Diodes			
MR 8106	½A	400V		Silicon	Thorn A.E.I.BY114
MR 8107	½A	400V		Silicon	" " "
MR 8108	½A	400V		Silicon	" " "
MR 8109	½A	400V		Silicon	" " "
MR 8110		Not Fitted			
MR 8111	½A	400V		Silicon	Thorn A.E.I.BY114
MR 8112	½A	400V		Silicon	" " "
MR 8113	½A	400V		Silicon	" " "
MR 8114	½A	400V		Silicon	" " "
MR 8115		Not Fitted			
MR 8116	½A	400V		Silicon	" " "
MR 8117	½A	400V		Silicon	" " "
MR 8118	½A	400V		Silicon	" " "
MR 8119	½A	400V		Silicon	" " "
		Valves			
V 8101	C.V. 449				Mullard CV449
V 8102	E.C.F. 82				Thorn A.E.I.ECF82
V 8103	E.L. 86				Mullard EL86
V 8104	E.C.F. 82				Thorn A.E.I.ECF82
V 8105		Not Fitted			
V 8106	E.L. 86				Mullard EL86
V 8107	E.L. 86				Mullard EL86
V 8108	E.L. 86				Mullard EL86
		Transformer			
T 8101	With Mains Selector Fitted				RO50/W/1459


SIGNAL IN
PLUG IN UNIT
0100 THROUGH 1900
16 WAY
PINS
A − SIG
B + SIG
C + SIG
TRIG SAMPLE
VERTICAL O/P AMPLIFIER
2100 SERIES
+
−
POSITION
VOLTS/CM
GAIN
DC BAL
AC/DC
SET TRIG '0'
GAIN
BEAM LOCATE
STABILITY OVERIDE
CALIBRATOR
6100 SERIES
CAL OUT 1V
CAL OUT 10mV
VOLTS
INT TRIG AMPLIFIER
5100 SERIES
SET 0v O/P
SWEEP
TRIG SAMPLE
MULTITRACE UNBLANK
MULTITRACE TRIGGER
INT
EXT
SUPPLY
AC
TRIGGER GENERATOR
4100 SERIES
TRIG PULSE
SWEEP GENERATOR
7100 SERIES
SENSITVITY
TRIG SET '0'
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BEAM LOCATE
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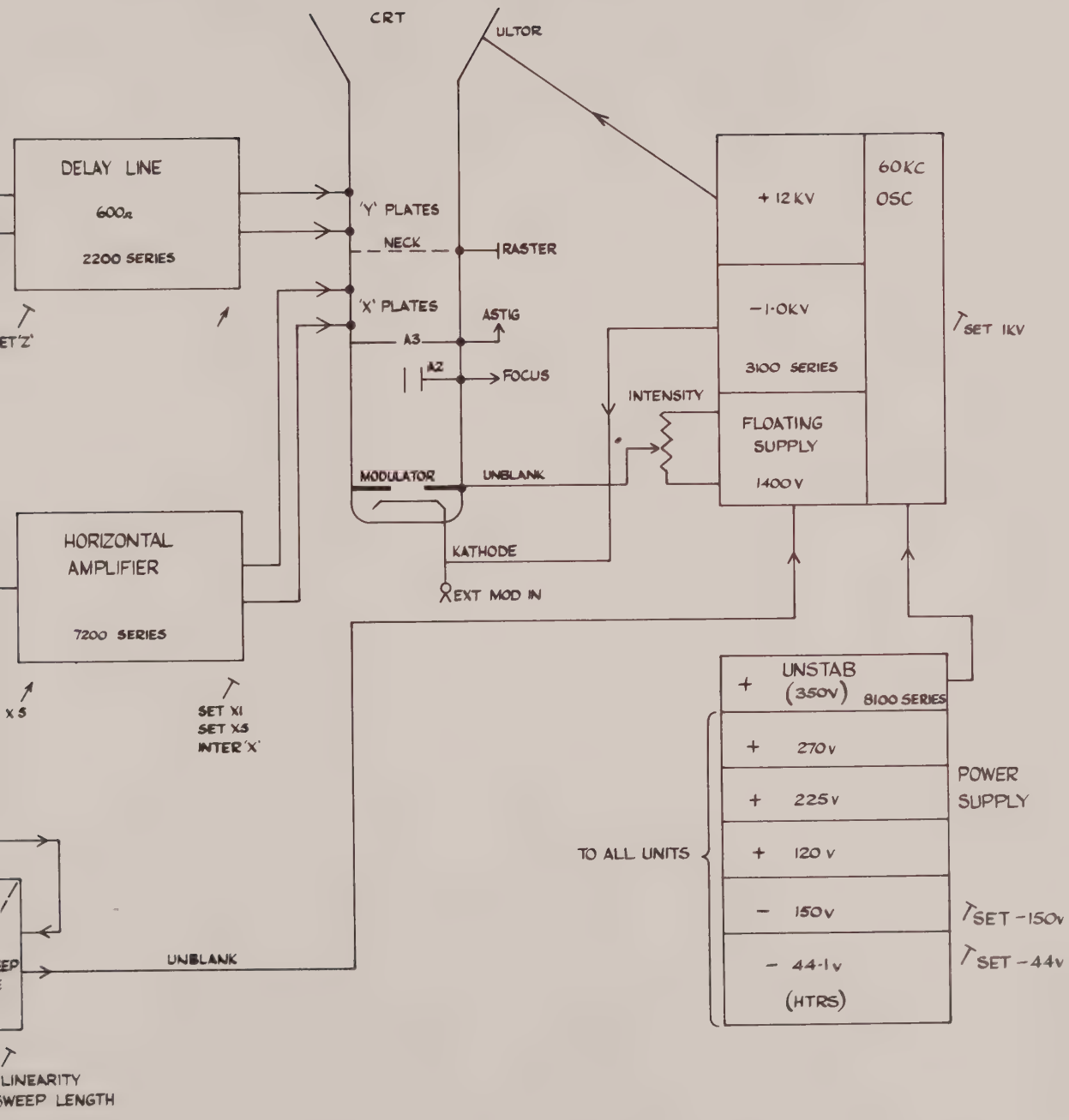
TRIGGER SLOPE
TRIGGER LEVEL
STABILITY
TIME/CM
VARIABLE
X POSITION

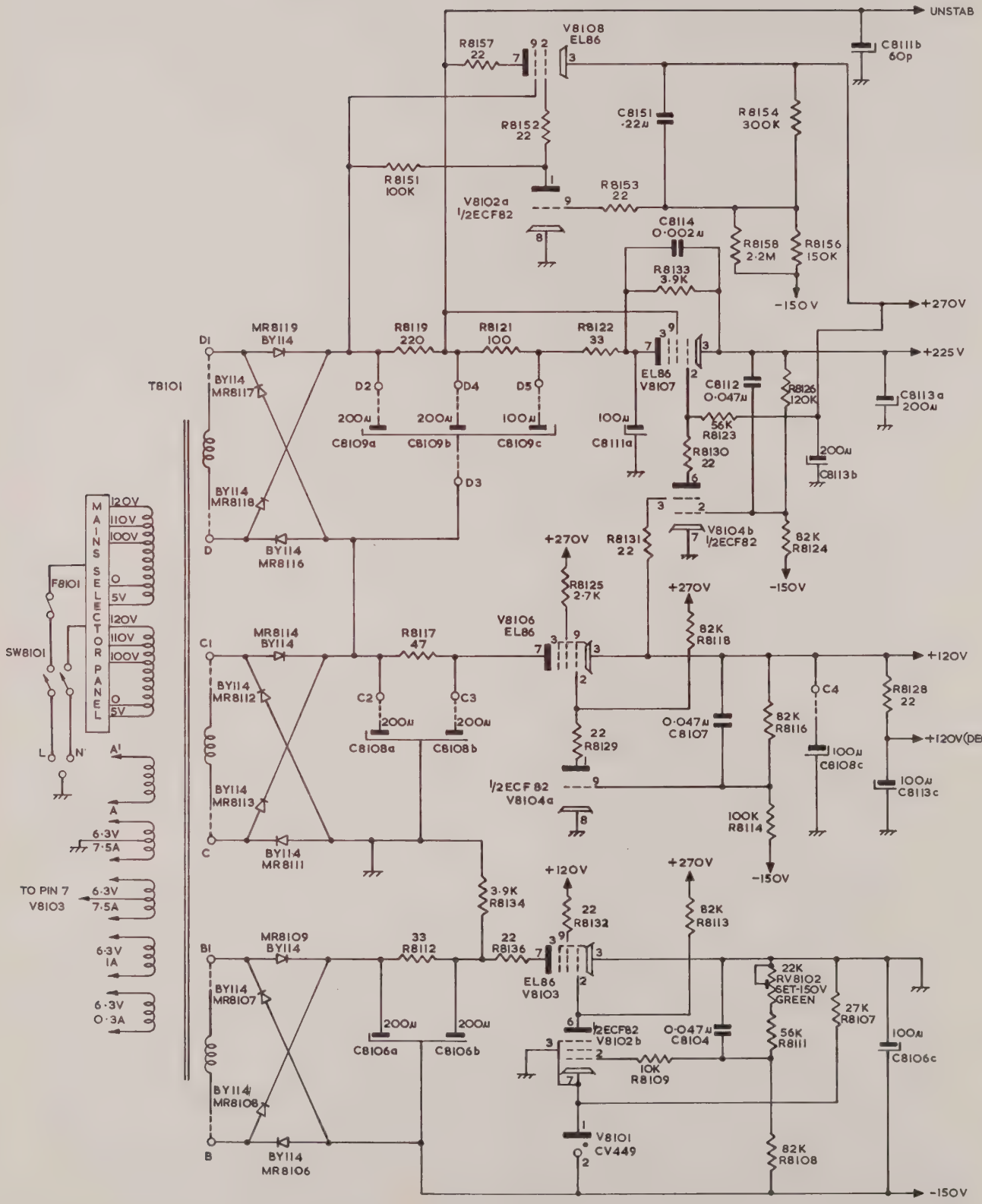


BLOCK DIAGRAM

FIG. 7. 1.

12·10·64.

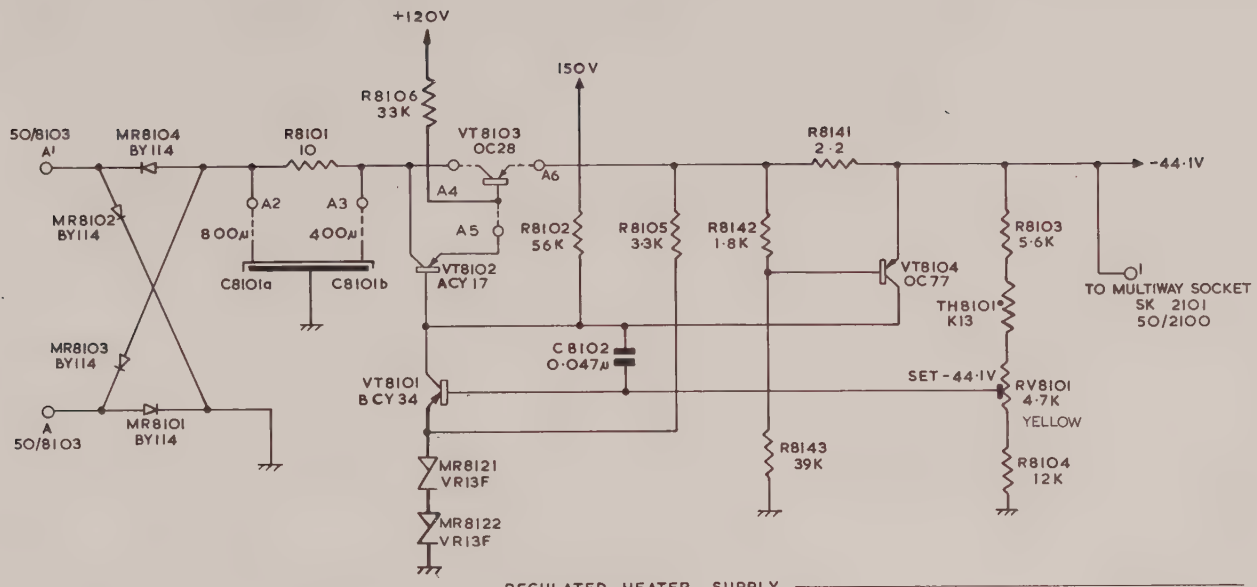
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3CYCLES
OF INTERNAL CALIBRATOR



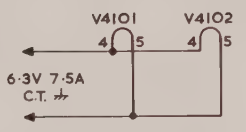
roband Oscilloscope Type ROSOA

POWER SUPPLY 50A/8104

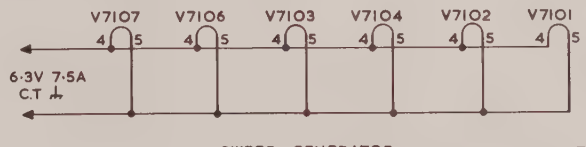
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3CYCLES
OF INTERNAL CALIBRATOR



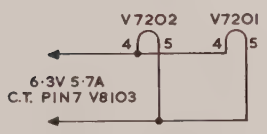
REGULATED HEATER SUPPLY



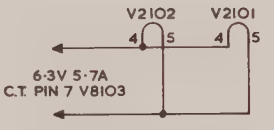
TRIGGER GENERATOR



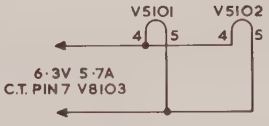
SWEEP GENERATOR



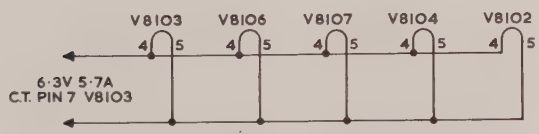
HORIZONTAL OUTPUT



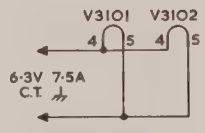
VERTICAL OUTPUT



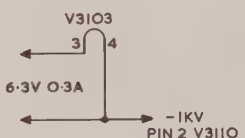
INT. TRIG. AMP.



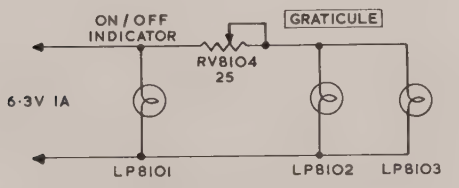
POWER SUPPLY



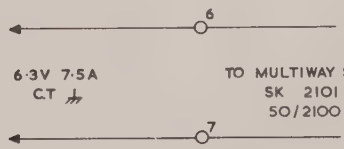
E.H.T. SUPPLY



C.R.T.



INDICATOR LAMP SUPPLY



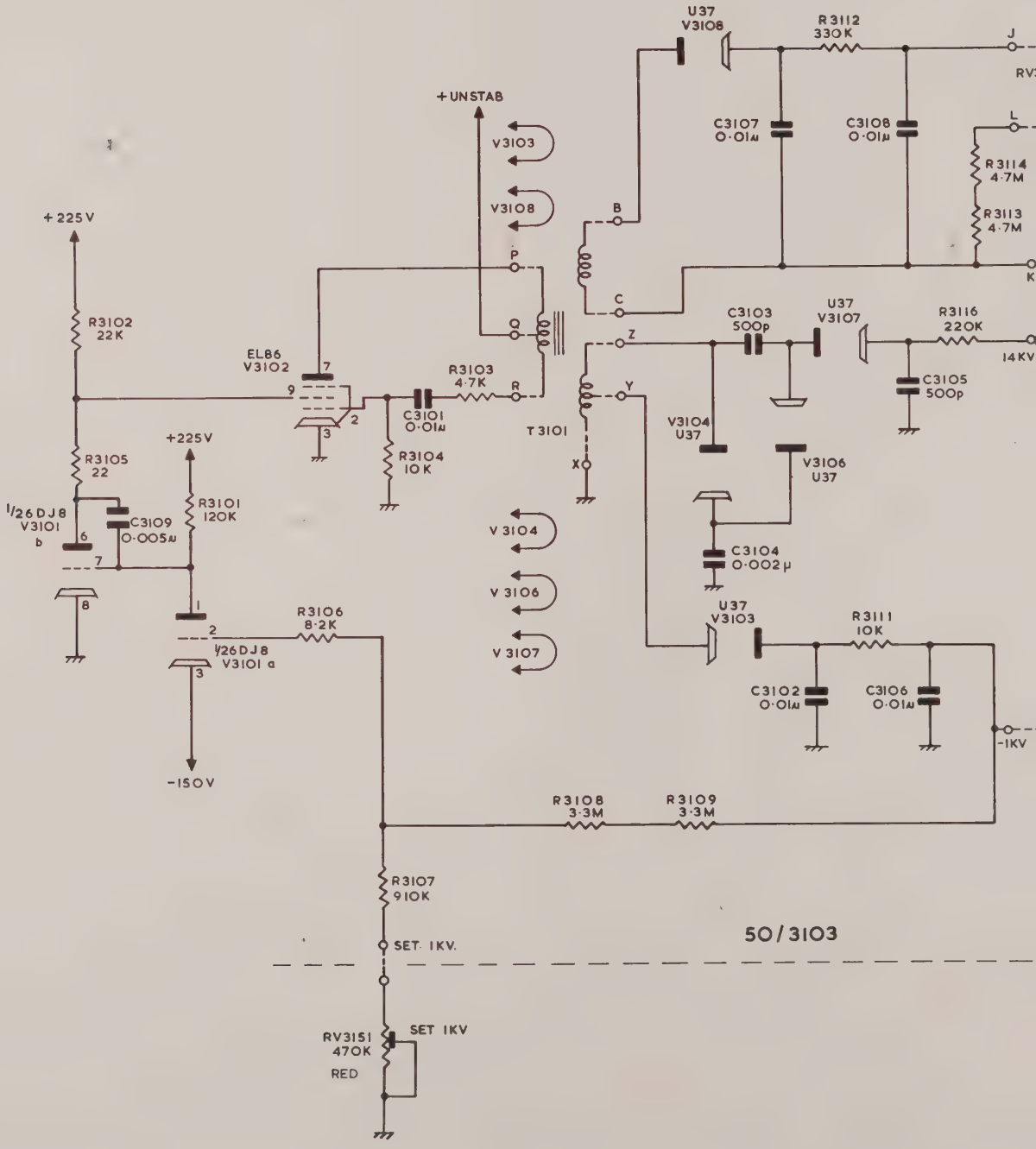
PLUG IN SUPPLY

Power Supply AND

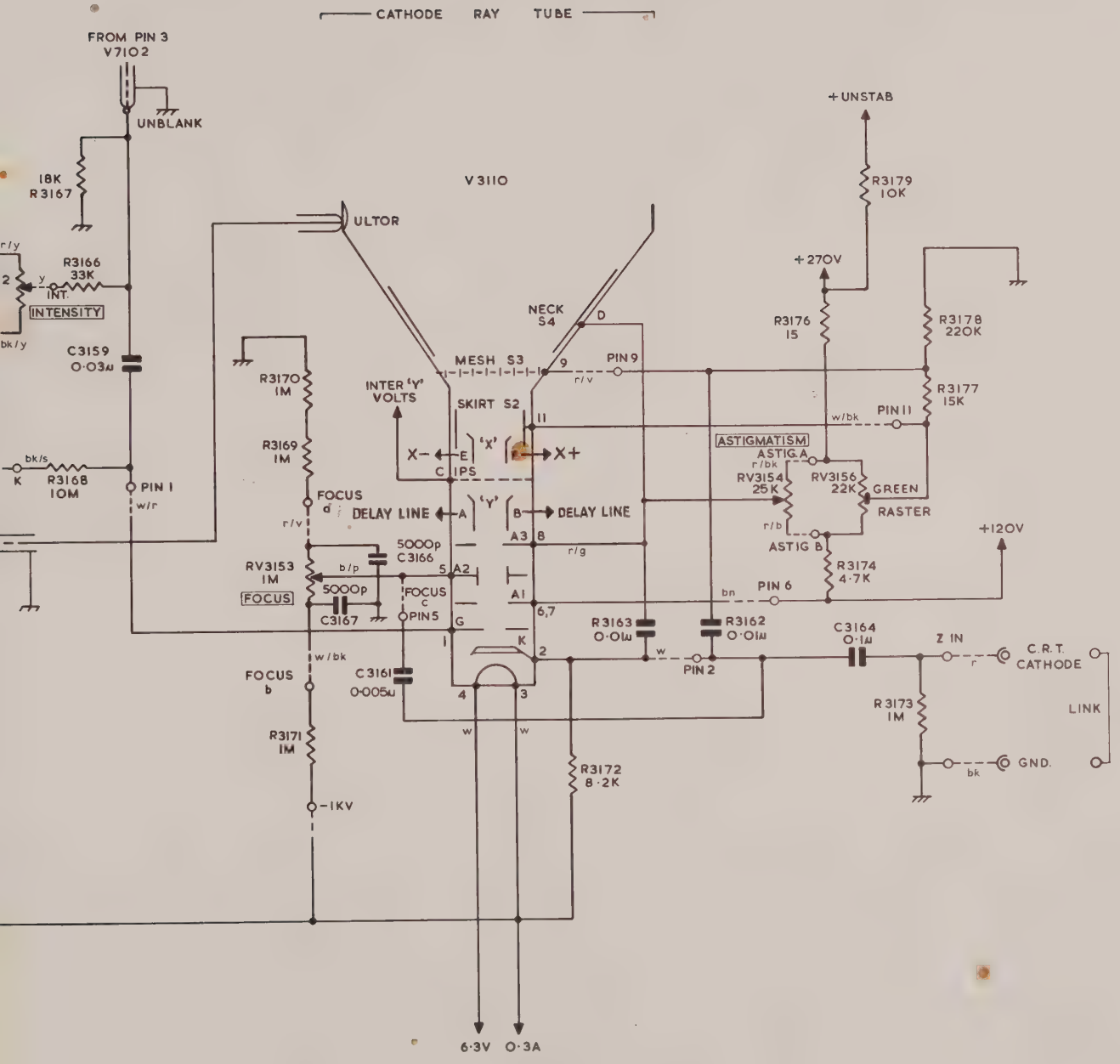
FILAMENT DISTRIBUTION DIAGRAM

BLUE —O + UNSTAB
ORANGE —O + 225V
WHITE / BLACK —O 6·3V
VIOLET —O −150V
BLACK —O GND.
WHITE / BLACK —O 6·3V
GREY —O SET 1KV
BLACK —O GND.
BLACK —O GND.
WHITE —O −1KV
BLACK —O GND.

CONTROL AMPLIFIER — RF OSCILLATOR



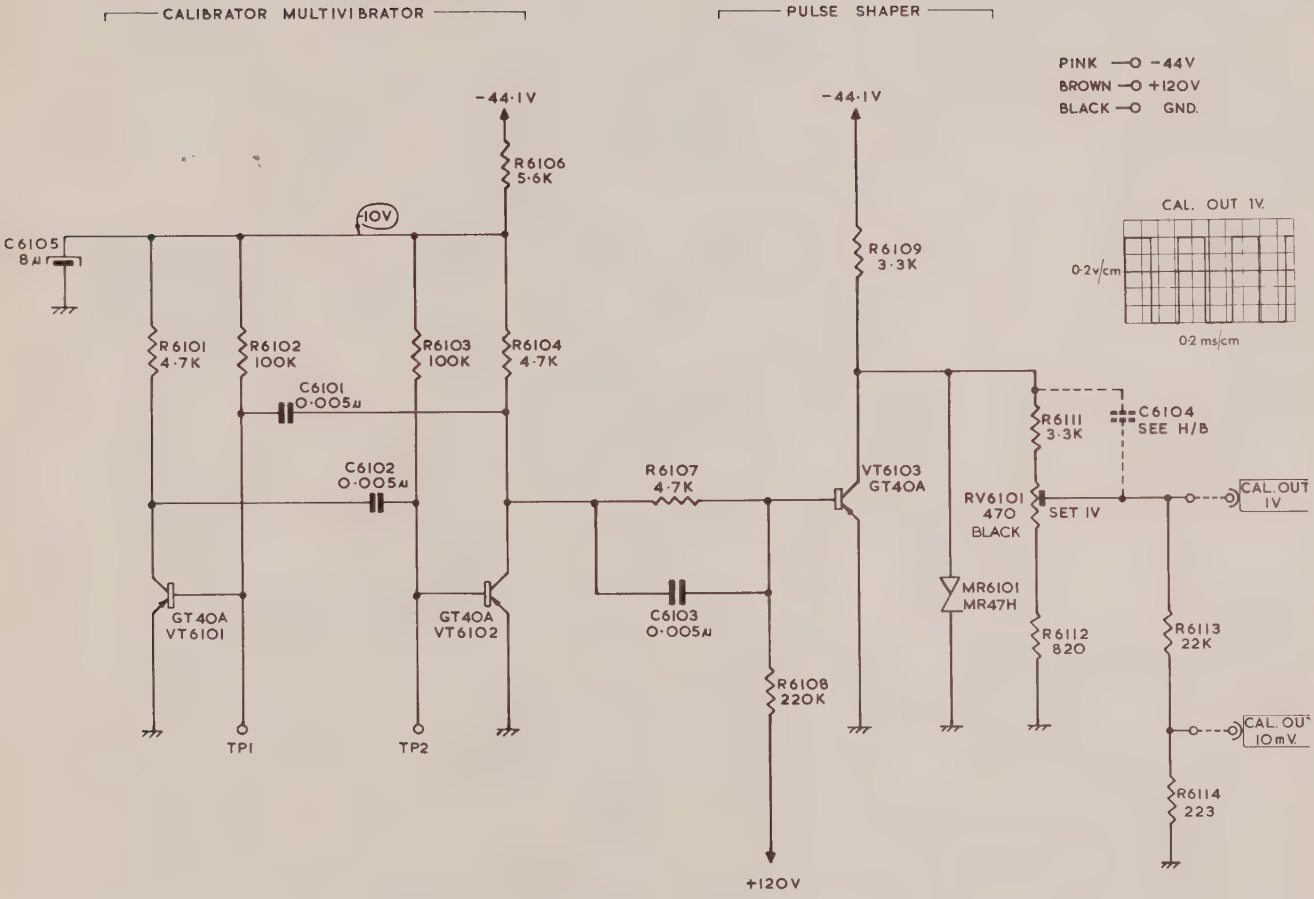
ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3CYCLES
OF INTERNAL CALIBRATOR



50A/3103
50A/3152

CATHODE RAY TUBE SUPPLY

ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND TRACE CENTERED ON SCREEN DISPLAYING 2CMS AND 3CYCLES OF INTERNAL CALIBRATOR



CALIBRATOR

ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND TRACE CENTERED ON SCREEN DISPLAYING 2CMS AND 3CYCLES OF INTERNAL CALIBRATOR

1 — -44·1V.
2 — -150 — 8µ C2152 — L2151 — +120 DEC
3 —
4 — +225 — 33 — R2151
5 — +270
6 — 6·3AC — 40µ C215K(a) — 40µ C2151(b)
7 —
8 —
9 — BEAMSWITCH TRIG FROM SWEEP GEN
10 — DUAL TRACE BLANKING OUT
11 —
12 — TO 'X' AMP
13 — 130V AC
14 —
15 — BEAMSWITCH TRIG OUT
16 —

MULTI-WAY SOCKET (PLUG IN BOX) SK2101

PIN 7 V2101
1v/cm
0·2 ms/cm

PIN 2 V2101
50mv/cm
0·2 ms/cm

+225V +225V

150 R2113
600 R2116
0·002µ C2101
L2103
200V
TO DELAY LINE 50/2201
S1
E810F V2101
0·002µ C2103
120K R2111
2·7K R2107
1·2K R2103
10K R2104
BEAM LOCATE
5000p C2121
TO 'J' TRIG GENERATOR 50A/4603
BEAM LOCATE SW2101
-150V

BLACK — GND
ORANGE — +225V
WHITE / RED — 6·3V
GREEN — INTER 'Y'

A — 110V — 10 R2108 — 100K R2102 — 100K R2101
100K R2118
0·002µ C2108
TO PIN C C.R.T. 50/3103
(INTER Y)
100K R2119
100 SET GAIN BLACK RV2101
2·7K R2106
120K R2112
B — 110V — 10 R2109
C2104 0·002µ
E810F V2102
C — TO INT. TRIG. AMP. 50/5101
S2

C2106 0·002µ — V2101 — C2107 0·002µ
L2107 — L2016
C2109 0·002µ — V2102 — C2111 0·002µ
L2111 — L2109
6·3V

C2102 0·002µ
L2104
200V
TO DELAY LINE 50/2201

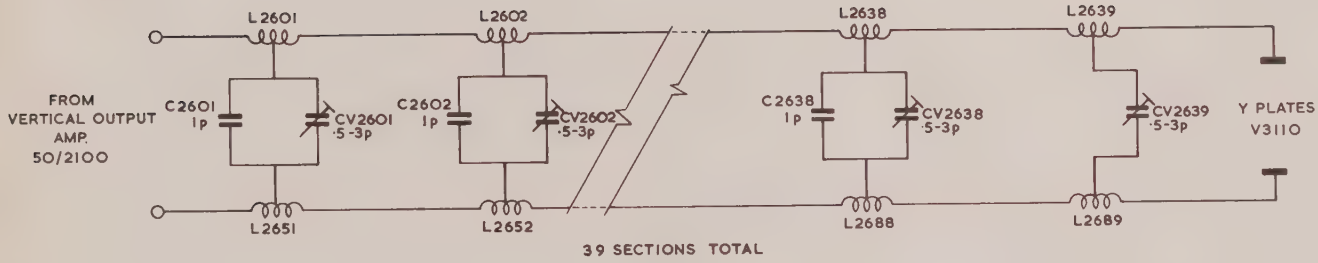
PIN 2 V2102
50mv/cm
0·2 ms/cm

150 R2114
600 R2117
0·22µ C2112
+225V +225V

PIN 7 V2102
1v cm
0·2 ms/cm

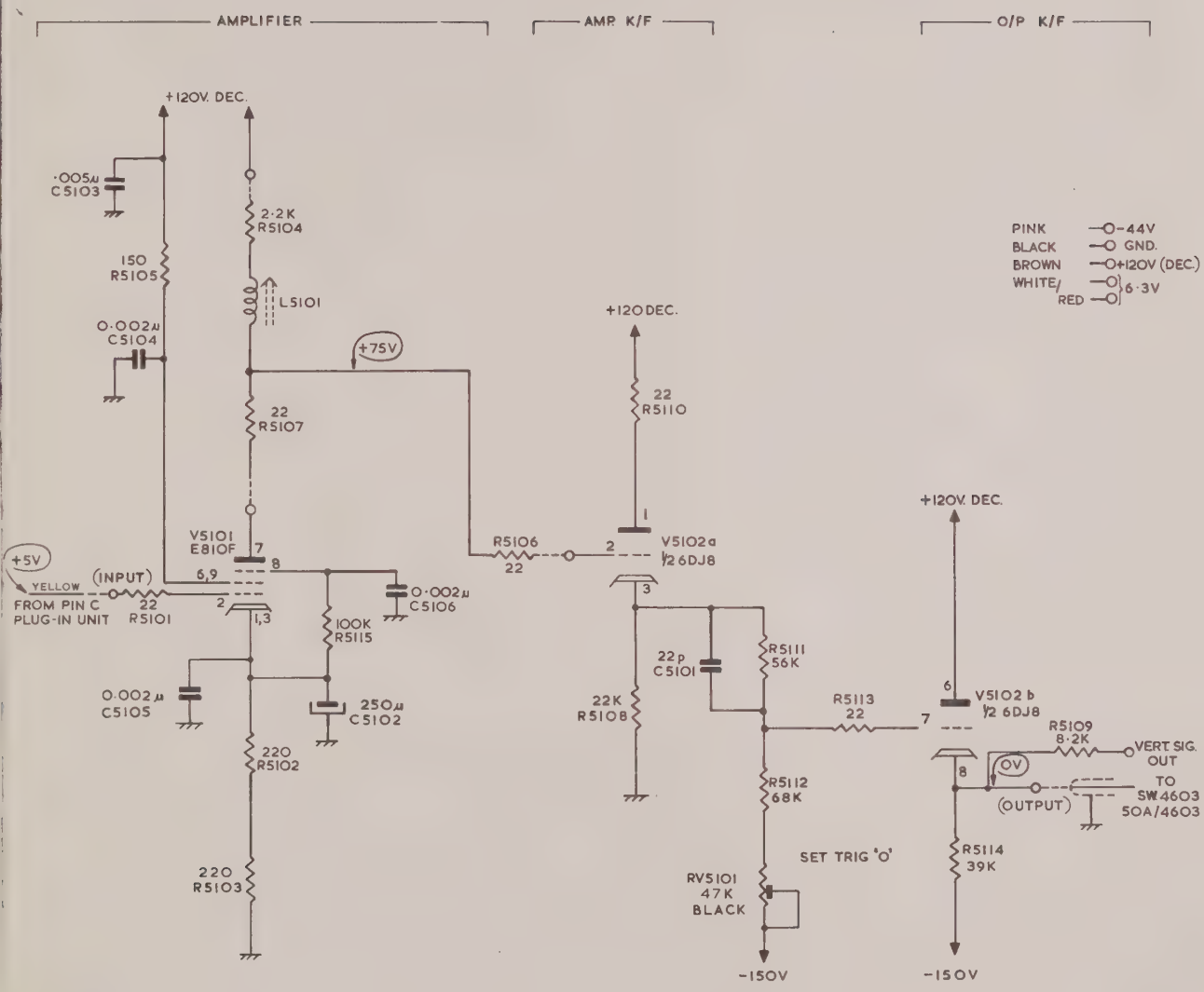
VERT OUTPUT AMP:

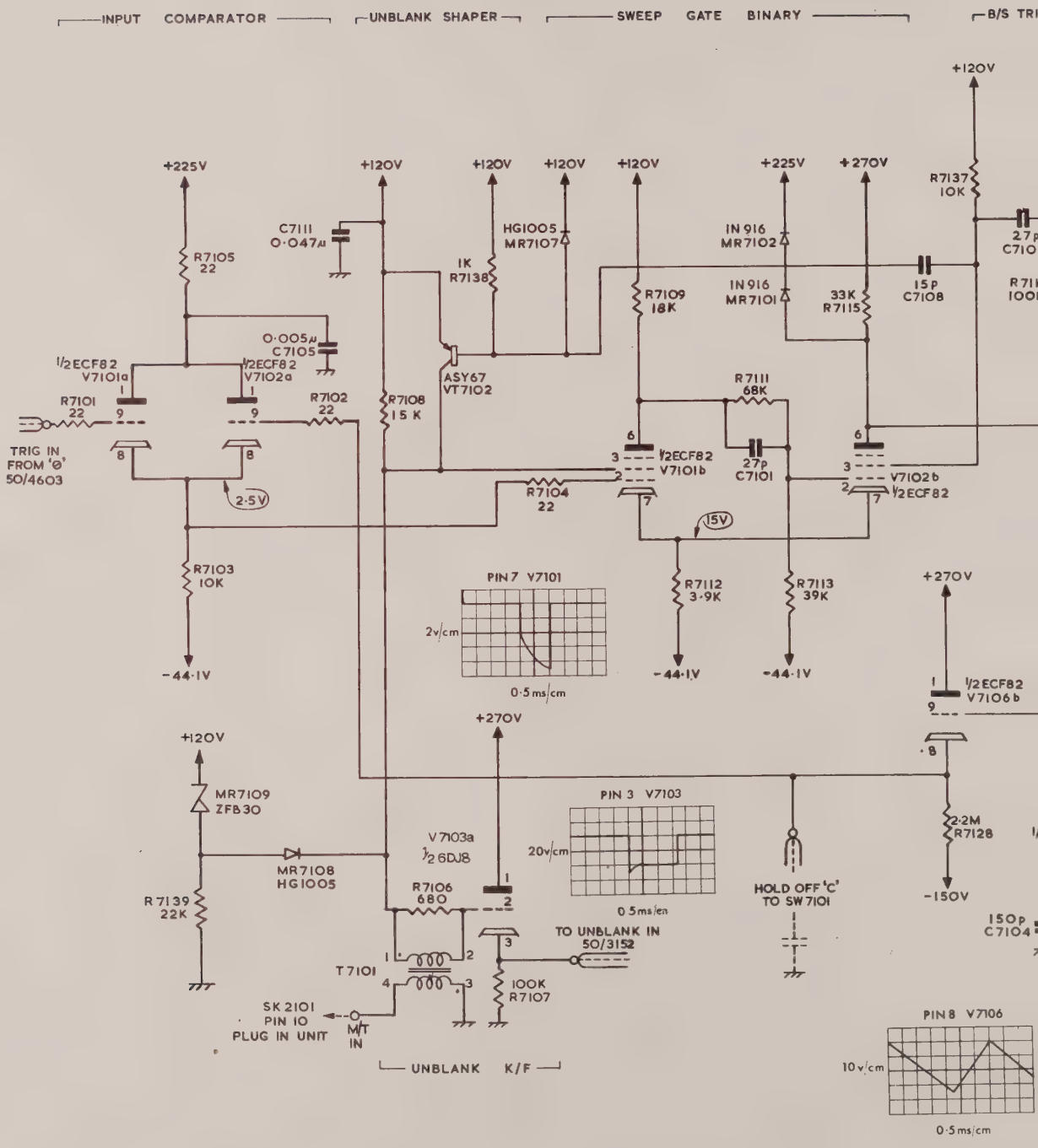
ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2 CMS AND 3 CYCLES
OF INTERNAL CALIBRATOR



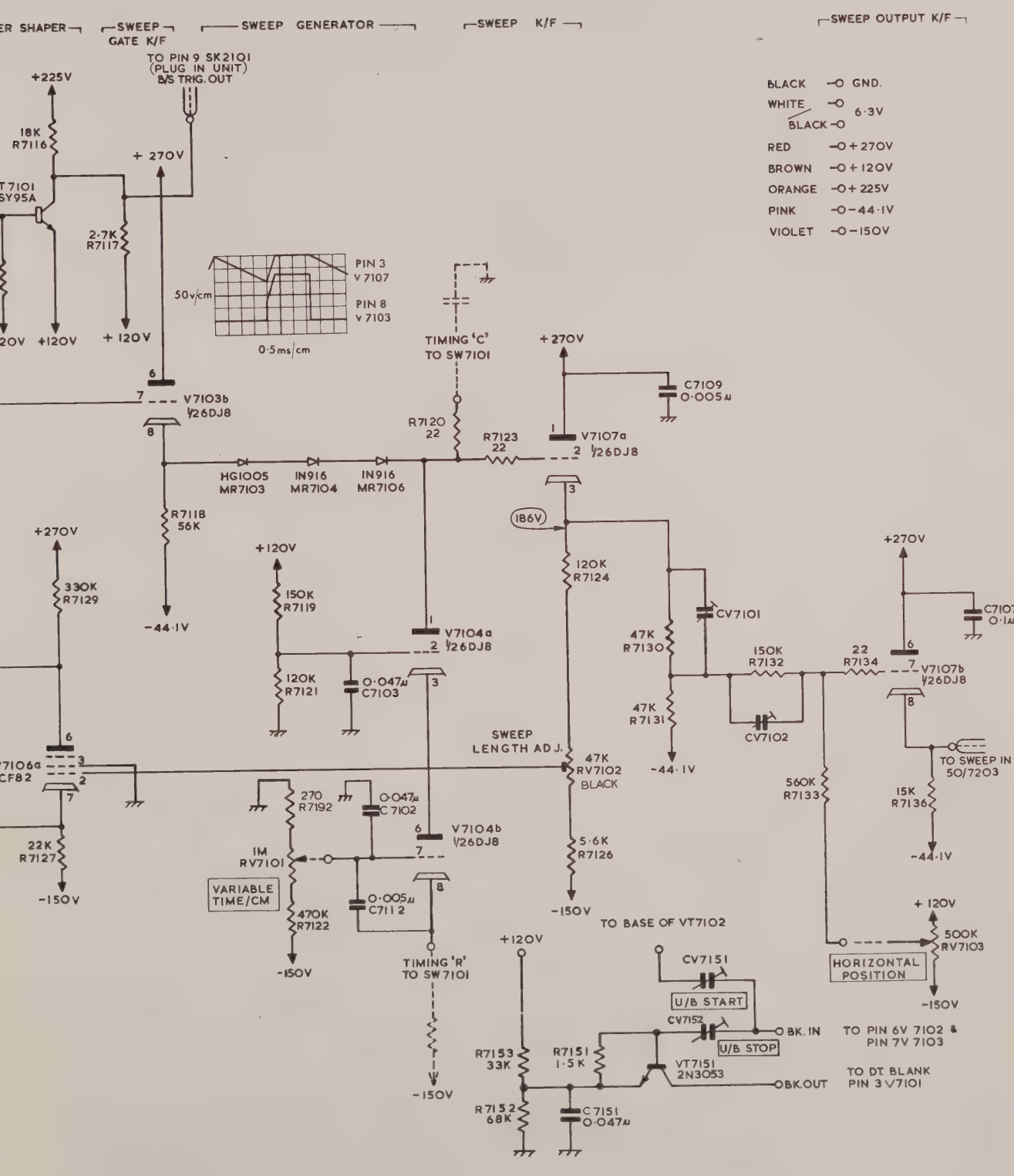
600SL DELAY LINE

ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3CYCLES
OF INTERNAL CALIBRATOR




INPUT COMPARATOR
UNBLANK SHAPER
SWEEP GATE BINARY
B/S TRI
+120V
+225V
+270V
R7137 10K
C7111 0·047µ
HG1005 MR7107
IK R7138
IN 916 MR7102
IN 916 MR7101
15p C7108
33K R7115
R7109 18K
R7105 22
0·005µ C7105
½ECF82 V7101a
½ECF82 V7102a
R7101 22
R7102 22
R7108 15 K
ASY67 VT7102
R7111 68K
27p C7101
½ECF82 V7101b
V7102b ½ECF82
R7104 22
2·5V
15V
TRIG IN FROM 'G' 50/4603
R7103 10K
-44·1V
PIN 7 V7101
2v/cm
0·5ms/cm
R7112 3·9K
R7113 39K
½ECF82 V7106b
MR7109 ZF830
MR7108 HG1005
R7139 22K
V7103a ½6DJ8
R7106 680
PIN 3 V7103
20v/cm
0·5ms/cm
TO UNBLANK IN 50/3152
HOLD OFF 'C' TO SW7101
2·2M R7128
-150V
150p C7104
T7101
100K R7107
SK 2101 PIN 10 PLUG IN UNIT
M/T IN
UNBLANK K/F
PIN 8 V7106
10v/cm
0·5ms/cm

ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3 CYCLES
OF INTERNAL CALIBRATOR



ALL RESISTANCE VALUES IN OHMS
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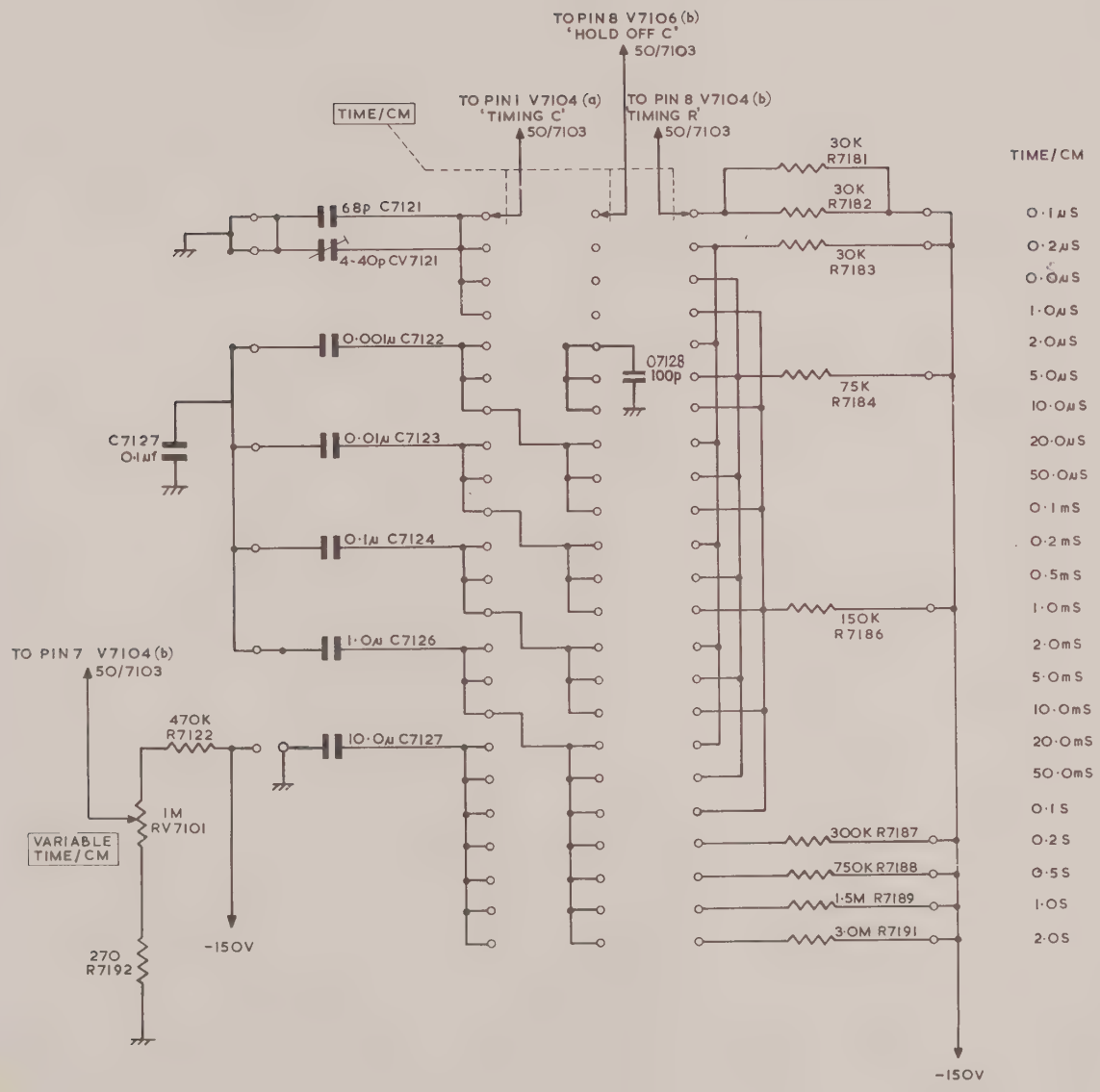
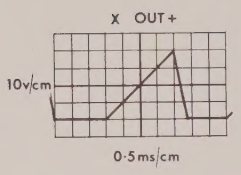
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3CYCLES
OF INTERNAL CALIBRATOR

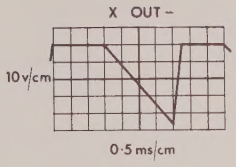


SWEEP TIMING SW.

ALL RESISTANCE VALUES IN OHMS
ALL CAPACITOR VALUES IN FARADS
VOLTAGES WITH 5K UNIT AND
TRACE CENTERED ON SCREEN
DISPLAYING 2CMS AND 3 CYCLES
OF INTERNAL CALIBRATOR

BLACK —o GND
ORANGE —o +225V
WHITE / RED —o —o 6·3V
—o SWEEP IN
VIOLET —o −150V
RED —o +270V

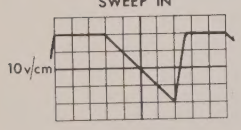




HORIZONTAL AMPLIFIER

+270V
8·2K R7203
+225V
R7228 10
HORIZONTAL OUT TO PIN E. C.R.T.
X OUT +
200
R7228 22
22 R7202
6
3
½ ECF804 V7201a
SWEEP IN 50/7103
22 R7201
2
820 R7223
SET X 5 470 RV7202 BLACK
2·2K R7224
SET X 1 4·7K RV7201 YELLOW
2·20p
CV7201
CV7202
A S.Q.T. B
MAG. SW7201 MAG.
X 5 MAG.
2·2K R7214
+55V
1
½ ECF804 V7201b
9
22 R7216
8
4·7K R7219
−150V

+270V
10K R7208
HORIZONTAL OUT TO PIN F. C.R.T.
R7229 10
X OUT −
200
22 R7209
6
½ ECF804 V7202a
3
2
7
+225V
R7229 22
+225V
56K R7207
+63V
47K RV 7204 D.C. SHIFT CENTRE BLACK
22 R7211
0·047µ C7201
47K R7226
−150V
2·2K R7212
+45V
1
½ ECF804 V7202b
9
22 R7217
−105V
8
4·7K R7218
−150V
39K R7221
22K RV7203 GREEN
SET 'X' VOLTS
0·002µ C7202
22K R7222
−150V

SWEEP IN


HORIZ AMP:

MP MASTER
MA24165